THE RELATIVE MAGNITUDE OF THE TRANS-GULF AND CIRCUM-GULF SPRING MIGRATIONS

BY HENRY M. STEVENSON

RECENT studies of the spring migration of birds, like earlier investigations, indicate the existence of routes both around and across the Gulf of Mexico. The present study attempts to determine which species (if any) utilize one of these routes to the exclusion of the other, which species predominate on each route, and which use the two routes about equally. Evidence pertinent to the problem comes from three sources: (1) direct observation of migrating birds; (2) the comparative abundance of birds around the Gulf in spring; (3) the sequence of spring migration arrival dates. Telescopic observations of birds crossing the face of the moon, since they do not distinguish between species, are not useful in this study.

Acknowledgments

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Mrs. Alice S. Marionneaux, Raymond A. Paynter, Jr., E. M. Reilly, Jr., Stephen M. Russell, Alexander F. Skutch; *West Indies:* James Bond, Florentina Garcia de Montana, Lawrence H. Walkinshaw.

Evidence from Direct Observation

Trans-Gulf Migration.—Lowery and Newman (1954) listed 73 species of non-pelagic birds which have been seen over the open Gulf, and recent observations of others have added a few more. Circumstantial evidence strongly indicated that the great majority of these were engaging in a true migration across the Gulf of Mexico. Considering the fact that many of them were small land birds which migrate largely at night, and that the opportunities of seeing small birds migrating over water are ordinarily fewer, even by day, than for those following land routes, this list is fairly impressive. (Moderate to large numbers of land birds are regularly present on the Dry Tortugas, Florida, in spring, but I saw only one—a Palm Warbler (*Dendroica palmarum*)—on a 12-hour boat trip from Key West to the Tortugas and return, March 23 and 30, 1951.) There is reason to doubt, however, that the list is an infallible index as to which birds are the most common components of the trans-Gulf spring migration. Moreover, in addition to birds seen offshore, some of those seen from land may be safely classed as trans-Gulf migrants. Among my own records have been two thrushes (*Hylocichla* sp.) flying low over the water, in the face of a strong north wind, toward the Alabama coast on April 26, 1952 (one was later determined to have been an Olive-backed Thrush, *H. ustulata*); a Veery (*H. fuscescens*) at the same place under similar circumstances on April 30, 1955; and a Chimney Swift (*Chaetura pelagica*) coming into Alligator Point, northwestern Florida, April 19, 1954. Similar observations have been reported to me by others.

Some references to trans-Gulf migration have implied a flight originating in Yucatan or Central America, but there is some direct evidence that an important flight also originates from, or crosses, the West Indies and continues across the Gulf in a northwesterly direction. On Loggerhead Key, the outermost of the Dry Tortugas, John DeWeese and I observed an Osprey (*Pandion haliaetus*) approach from the southeast and continue across the island and over the Gulf until it disappeared from sight to the northwest. At dusk that day (March 25) a small flock of Yellow-crowned Night Herons (*Nyctanassa violacea*), calling continuously, followed the same route. Consideration of the winter ranges of certain species, coupled with their distribution in spring, leads me to suspect that this is a widely used migration route. The occasional (or regular?) occurrence as far west as Texas of such species as the Black-poll Warbler (*Dendroica striata*) and the Cape May Warbler (*Dendroica tigrina*) is more logically accounted for in this way than by the sup-

position that they have followed a land route northward, then westward, around the Gulf.

Another trans-Gulf route, roughly parallel to this one, extends from Yucatan to the Texas coast (Lowery and Newman, 1954). Quantitative data secured in the course of the present study lead me to agree that this route, not often mentioned in the literature, is followed by many birds.

Circum-Gulf Migration.—If this term be used to include all coastwise migration on the Gulf of Mexico, many observations confirm its magnitude. However, it is both logical and patent that birds wintering in the West Indies often move northward along the Florida Peninsula, and that those which winter in eastern Mexico fly along the Texas coast. More pertinent questions are, "To what extent are these routes utilized by birds wintering in Central and South America?" and "Do these migrants continue eastward (from Texas) and westward (from peninsular Florida) around the northern Gulf coast?" In the case of a few species, the second question may be answered in the affirmative. In northwestern Florida, White Pelicans (*Pelecanus erythrorhynchos*) and White Ibises (*Eudocimus albus*) may be seen following the coast westward in spring, and Williams (1945) has cited records of a northeastward movement of Broad-winged Hawks (*Buteo platypterus*), Little Blue Herons (*Florida caerulea*), four species of swallows, and a few other small land birds around Galveston Bay, Texas. Other records of this nature are represented in Table 3. Such direct observations cannot show the entire route followed by an individual bird in its spring migration, nor do they reveal its winter and summer homes. Therefore they fail to solve some of the problems of migration, and other lines of evidence, even through circumstantial, must be sought.

Comparative Abundance of Migrants around the Gulf

The statement has been made that no transient species is more common along the northern Gulf coast than on the Texas or Florida coasts, but only 56 species formed the basis for the statement (Williams, 1945: 103). The basis for this comparison, except in Texas, was information gleaned from such standard reference works as the state bird books, which used such descriptive terms as "common" and "fairly common" instead of numerical data. That these terms are often misleading is exemplified by Howell's (1932) statement that the Wood Thrush (*Hylocichla mustelina*) is a "fairly common migrant in central Florida." Howell cited only a single spring record for the mainland south of the northern tier of counties (where it breeds). The 23 intervening years have produced very few more. Another innocent error committed by Williams in making this comparison was that of treating as units areas which are ornithologically diverse. For example, the region called the "Florida Peninsula and Keys" consists of the following: (1) the Northern Peninsula,

FIG. 1. Regions Represented by Quantitative Data. 1. Western Tennessee; 2. Northwestern Mississippi; 3. Central Tennessee; 4. Northern Alabama; 5. Northern Georgia; 6. Southwestern Virginia (including northeastern Tennessee); 7. Charlottesville, Virginia; 8. Richmond, Virginia; 9. Virginia-North Carolina Coast; 10. Northwestern Louisiana;

in which most species of transient land birds are scarce (Longstreet, 1930 and 1939; Mason, 1937 and 1939; McClanahan, 1935); (2) the Southern Peninsula, where most of these species are less scarce; and (3) the Lower Keys and Dry Tortugas, where the abundance or regular occurrence of certain species is astonishing to a visitor from the mainland.

An inspection of the winter and summer ranges of North American birds shows that, instead of the 56 species tabulated by Williams, at least 200 may be expected on geographical grounds to cross the Gulf of Mexico with some regularity. Whether these be classed as transients, winter residents, or summer residents along the northern Gulf coast, all are to be considered in an exhaustive study of the problem. Discrepancies such as that mentioned for the Wood Thrush made it advisable to conduct a cooperative study of the relative abundance of migrant species in the southern United States. Between 1946 and 1955 cooperators were asked to record the numbers of individuals of all birds seen from early March to late May, as well as the length of time they spent afield. By dividing for each species the total number of individuals seen by the number of observer-hours afield in a given region, a "frequency" was obtained which could be compared with the frequency of that species in other regions. It was requested that these field data represent a balance of the various habitats, weather conditions, and times of spring (Table 1). The role of chance was further reduced by combining the records of several observers and several localities in each region, and by the fact of the large amounts of field work in each region (not less than 150 hours). The latest revision of these data brought about such minor changes in the frequencies of most species that I am convinced of their general significance. In this connection, the *magnitude* of the differences in many of the frequencies on the northern Gulf coast compared with those on the Florida Peninsula, for example, should be cited in support of the conclusions reached. The 24 regions contributing quantitative data are shown on Fig. 1.

Analysis of Inland Regions.—Results are generally consistent except for species requiring special habitats (waterfowl, etc.). Many transients and summer residents are comparatively common at least 200 miles north of the Gulf, illustrating the "coastal hiatus" of Lowery (1945, *et seq.*). Values for transient land birds at Tallahassee, Florida, just 30 miles inland, are particularly low. Very high counts and estimates were made at Rosedale (northern

11. Brownsville, Texas; 12. Corpus Christi, Texas; 13. Galveston, Texas; 14. Louisiana Coast; 15. Alabama Coast (including northwestern Florida); 16. Tallahassee, Florida; 17. Apalachee Bay, Florida; 18. Northern Florida Peninsula; 19. Southern Florida Peninsula; 20. Dry Tortugas, Florida; 21. West Indies (Western Cuba and Isle of Pines); 22. Southeastern San Luis Potosi, Mexico; 23. Veracruz, Mexico; 24a. British Honduras; 24b. Aguadulce, Panama.

TABLE 1

PERIODIC DISTRIBUTION OF QUANTITATIVE SPRING DATA, TEXAS TO FLORIDA

Values Given are the Percentage of the Observers' Time in the Field

Periods	REGIONS: Brownsville	Corpus Christi	Galveston	Southern Louisiana	Alabama Coast	Tallahassee	Apalachee Bay	No. Fla. Peninsula	So. Fla. Peninsula	Dry Tortugas
Mar. 1-15[1]	6.5	7	4	5	8	7.5	7.5	7.5	4.5	3
Mar. 16-31	17	17.5	16	18	14.5	17	15.5	15.5	17	18.5
Apr. 1-15	20.5	20.5	21	20.5	16	19	19	18	20.5	21.5
Apr. 16-30	27	27	27.5	28.5	26	25	27	25.5	25	25.5
May 1-15	22.5	21	22	19.5	23.5	18	18.5	21	20.5	20.5
May 16-31	6.5	7	9.5	8.5	12	13.5	12.5	12.5	12.5	11
TOTAL HOURS	169	311	151	189	158	274	310	166	424	169

[1]Including Feb. 26 in Southern Florida Peninsula.

Mississippi), but this may be due partly to the convergence of the trans-Gulf stream of migrants passing up the Mississippi River with birds veering northeastward from the Texas coast.

Analysis of Gulf Coastal Regions.—The results are believed to be significant for most species, but probably not for certain shore birds on the Louisiana coast. Frequencies are high for most species on the Dry Tortugas, both for trans-Gulf and circum-Gulf migrants. This is due in part to the concentrating effect of small islands, as well as the probable lingering of individuals for several days, with the result that the same birds were counted more than once. The occurrence there of numbers of species that winter in Central America is usually correlated with westerly or southwesterly winds (Bennett, 1909), as these species ordinarily cross nearer the center of the Gulf.

Analysis of Tropical Regions.—Quantitative field data were available from Cuba, the Isle of Pines (Walkinshaw and Baker, 1946), British Honduras, and Veracruz, and semi-quantitative data from eastern Mexico (Sutton and Burleigh, 1940; Sutton and Pettingill, 1942). It is very doubtful whether these data should be freely compared with those from within the United States in view of the great differences in objectives and methods used in the several regions. Furthermore, because of the need of obtaining as much data from the tropics as possible, I have not selected trips to give a balance for the various periods of spring but used all data available, thus invalidating strict comparisons of these sets of data with each other and with those from within the

Table 2

Periodic Distribution of Quantitative Spring Data South of the United States
Values Given are the Percentage of the Observers' Time in the Field

	San Luis Potosi	Veracruz	Central America	Greater Antilles
March	28.5	32	43	41
April	66.5	36	41	34
May	5	32	16	25

United States (Table 2). Especially have I been cautious in using the semi-quantitative data of Sutton *et al.*, since the numbers used in the study were often based on my own inferences from reading the text.

Sequence of Migration Dates

From state bird books and other regional lists, papers in state and national journals, and unpublished data received from cooperators, the earliest and latest spring records of the species included in this study were determined in each of 25 regions comparable to those from which quantitative data were ob-obtained (Fig. 2). The significance of this type of data has been the subject of some debate. It has been contended that the sequence of migration dates proves practically nothing. This would indeed be true if each species arrived simultaneously at all points north of its winter range. However, inasmuch as every species appears earlier in some parts of the country than in others, the time of its arrival at various points can indicate the course of its journey.

The danger that lies in the use of migration dates is that of attempting to prove too much from too little. Chance plays so large a part in determining the *recorded* occurrences of species (as opposed to their presence without our knowledge) that data in small amounts actually may prove very little.

In the present study this principle of increasing the amount, and therefore the significance, of the data was applied in several ways. (1) All migration dates from one region have been lumped. For example, the Northern Georgia region includes data from Atlanta, Athens, Dalton, Demorest, Augusta, and Macon. The 25 regions represented cover the entire southeastern United States, eastern Mexico, Central America (including Mexico east of the Isthmus of Tehuantepec), and the West Indies. Even data of this type from the tropics, however, are hardly comparable to those from within the United States. (2) The "average" arrival date was not employed in this study, as it usually consists of representative dates (when the observer was afield frequently) averaged with spurious arrival dates (when opportunities for field work were restricted). Arrival dates used in this study are considered the

earliest normal dates for the region. In many instances, perhaps most, they are the earliest of record in that region. Very exceptional records, however, were omitted, as they might represent wintering, might have been based on faulty identification, or might in some way be anomalous. This introduced the problem of determining which early dates to consider exceptional and which representative. For common species a date five days in advance of the next earliest was considered "out of line," but for less common species a difference of a week or more was required to establish abnormality. Normal and abnormal departure dates were determined in much the same way. (3) In view of the fact that the earliest known record of a species is likely to be earlier in a region where it is common than in one where it is rare—and that, similarly, departure dates are usually later in the region where the bird is common—a *median* date was employed wherever possible. This is simply the date which lies half-way between the earliest and latest normal dates. Use of this date often showed a progression of migration that would not have been apparent from a comparison of arrival dates or departure dates alone.

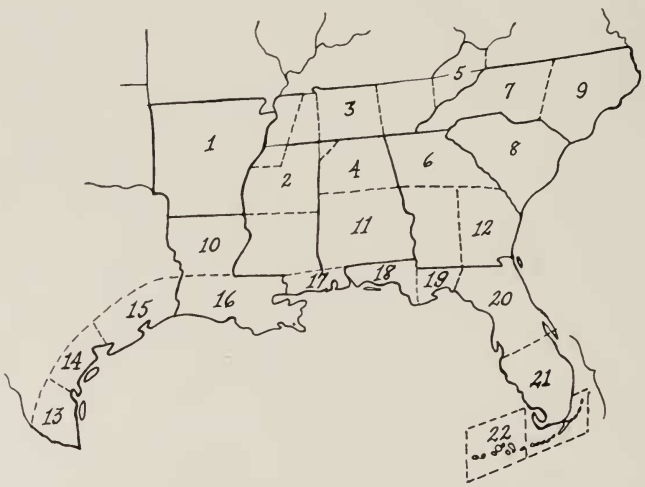

Fig. 2. Regions in the United States represented by migration dates. (Boundaries which do not coincide with state lines are indicated with broken lines.) 1. Arkansas (including western Tennessee and northwestern Mississippi); 2. Northern Mississippi (including northwestern Alabama); 3. Central Tennessee; 4. Northern Alabama; 5. Northeastern Tennessee-southwestern Virginia; 6. Northern Georgia; 7. Western North Carolina; 8. South Carolina; 9. Eastern North Carolina; 10. Northern Louisiana; 11. Central Alabama; 12. Southeastern Georgia; 13. Brownsville, Texas; 14. Corpus Christi, Texas; 15. Galveston, Texas; 16. Southern Louisiana; 17. Mississippi-Alabama Coast; 18. Northwestern Florida; 19. Tallahassee, Florida; 20. Northern Florida Peninsula; 21. Southern Florida Peninsula (including Upper Keys); 22. Lower Florida Keys.

Use of Maps

Maps were made (Figs. 3-62) showing the winter and summer ranges of each species, even though distribution south of the United States could not always be accurately determined. The frequencies were then plotted on these (odd-numbered) maps, and isoplethal lines were drawn in. (It is not intended that these lines imply certain frequencies for areas outside that under consideration, however close these areas may be.) Frequencies were enclosed in parentheses if they appeared to be no higher than values for the same species in winter or summer, but this was difficult to determine south of the United States. The symbol ".00+" was used to indicate the spring occurrence of species not recorded in the quantitative data used in the study. Superscript letters following these frequencies convey additional information: "a", May be as frequent in summer; "b", May be as frequent in winter; "c", Probably occurs more frequently (whenever these values were lower than those implied for the species by other workers, or lower than they would have been if all quantitative data received from that region had been used in the study). Appropriate symbols (A+, L–, etc.) compared the status of each species in coastal Mississippi (Burleigh, 1944) to its status on the Alabama or Louisiana coast. The area of maximum abundance was shaded. Also all records of birds seen on the Gulf of Mexico were located on these maps by geographic position, date, and number of individuals.

On similar (even-numbered) maps migration dates were transcribed, whether the arrival, median, or departure date, and isochrones used to show the species' advance. Whenever more than one kind of information was given on a single map, appropriate letters before a date show whether it is an arrival, median, or departure date (A, M, or D). Parentheses were placed around all dates based on six or fewer records, indicating their lesser significance. On these maps, "a" associated with a date indicates that exceptional records were omitted from consideration and "b" that the date probably is not representative.

General Results

Comparative Abundance.—From this study it was determined that about 40 species of birds occurred more frequently along the northern Gulf coast than on its eastern and western sides. Although some of these may be open to suspicion on the grounds that they are also more common there in summer or winter, at least 16 of these are primarily of transient status. If the Texas coast north of Brownsville be included with the northern Gulf (on the assumption that many birds arrive there from across the Gulf) the list is greatly increased. The abundance on the Texas coast of certain species which

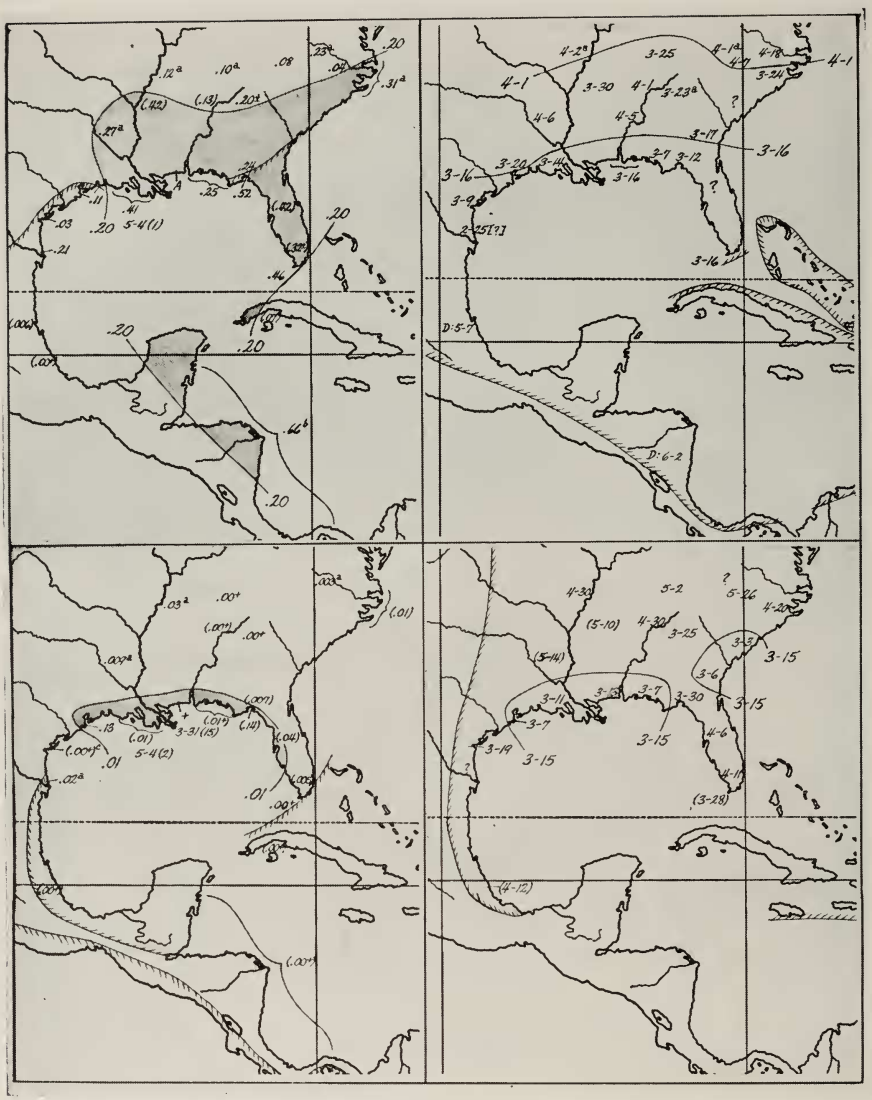

FIG. 3 (upper left) Comparative Abundance and FIG. 4 (upper right) Arrival Dates for the Green Heron.

FIG. 5 (lower left) Comparative Abundance and FIG. 6 (lower right) Arrival Dates for the Least Bittern.

(See text page 47 for further details concerning these maps.)

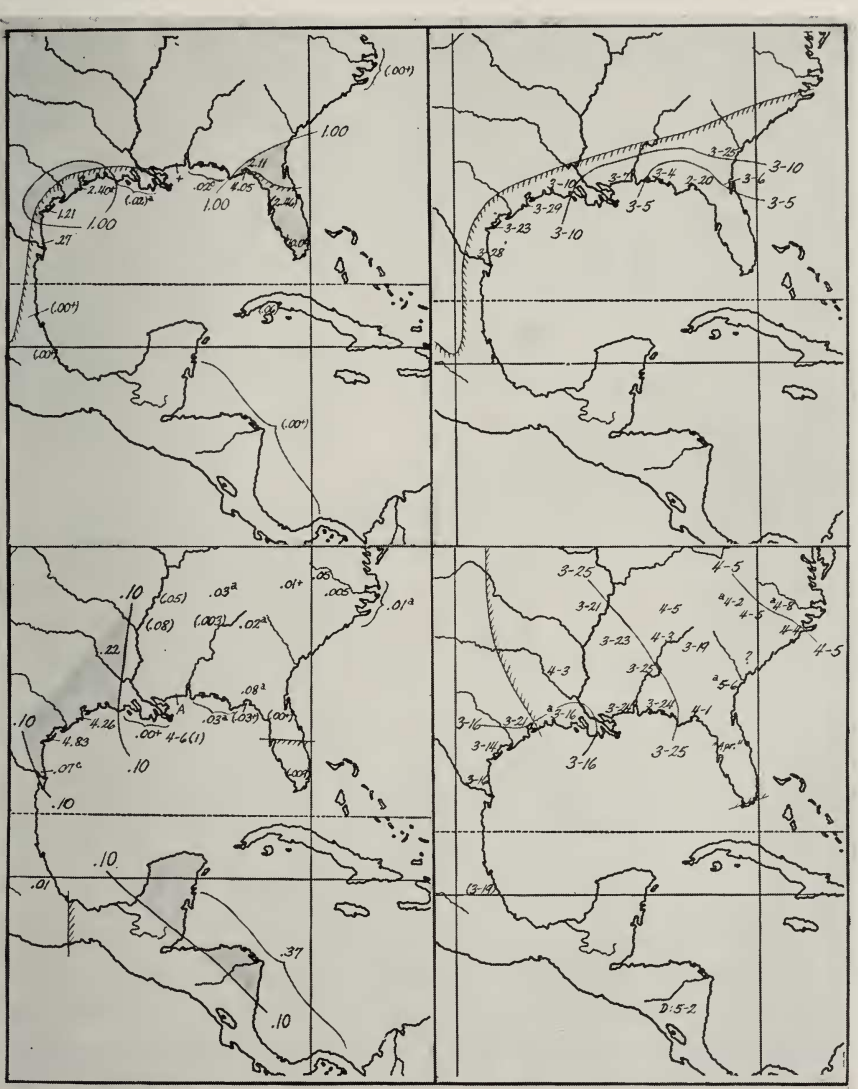

Fig. 7 (upper left) Comparative Abundance and Fig. 8 (upper right) Arrival Dates for the White Ibis.

Fig. 9 (lower left) Comparative Abundance and Fig. 10 (lower right) Arrival Dates for the Broad-winged Hawk.

breed in the eastern United States is surprising, but their occurrence is probably due in part to the prevailingly easterly winds over the Gulf of Mexico in spring. An observer (DeWeese) stationed on the Tortugas recorded easterly winds on 63 of the 101 days on which observations were made; another (Lockwood) at Rockport, Texas, on 66 of 82 days. Furthermore, some species' breeding ranges extend entirely across North America and their winter ranges lie in South America. Therefore an important segment of the population of such species as the Common Nighthawk (*Chordeiles minor*) and Olive-sided Flycatcher (*Nuttallornis borealis*), and of most species of swallows must cross the Texas coast in a direct flight from wintering to breeding grounds. Although the evidence that many species are less common in eastern Mexico than on the Texas coast may still be inconclusive, it is much better validated now than 10 years ago. I submit that the burden of proof that the two are ornithologically similar, insofar as transient species are concerned, now rests on any who may make the statement.

Sequence of Migration Dates.—If migration across the Gulf of Mexico does not occur, all species which appear on the northern side in spring should arrive there later (or certainly not earlier) than they appear *en route* there on the Texas or Florida coast. Conversely, migration across the Gulf, since it must occur in one continuous flight, would bring some individuals of the species to the northern side earlier than those which follow the longer land route, with its opportunities for frequent stopping. Therefore, trans-Gulf migrants should reach the coastal areas of northeastern Texas, Louisiana, Mississippi, Alabama, and northwestern Florida as early as, or earlier than, individuals of the same species arrive in southern Texas or the Florida Peninsula. Departure dates of species which are common in winter on the northern Gulf coast are difficult to interpret. Although later dates here in spring may seem to support the theory of circum-Gulf passage, I believe that in some cases these belated individuals have crossed the Gulf. Later departure dates on the sides of the Gulf, however, seem indicative of a circum-Gulf migration.

This study of the sequence of migration dates indicated that many species utilize the trans-Gulf migration route to some extent in spring. These include some which are of greatest abundance on the northern Gulf coast in spring, but a number of others which are not (Table 3). I doubt seriously whether any small land birds other than swallows follow the northern Gulf coastline eastward or westward to any appreciable extent in spring.

An incidental result of this phase of the study was the discovery of early arrival (or median) dates along the Atlantic coast of certain species whose winter ranges include parts of the West Indies or South America. Such species were the Least Bittern (*Ixobrychus exilis*), Stilt Sandpiper (*Micropalama himantopus*), Least Tern (*Sterna albifrons*), Chuck-will's-widow (*Caprimulgus*

carolinensis), Common Nighthawk (*Chordeiles minor*), Cliff Swallow (*Petrochelidon pyrrhonota*), Veery (*Hylocichla fuscescens*), Red-eyed Vireo (*Vireo olivaceus*), Magnolia Warbler (*Dendroica magnolia*), Black-poll Warbler (*Dendroica striata*), American Redstart (*Setophaga ruticilla*), Bobolink (*Dolichonyx oryzivorus*), and Painted Bunting (*Passerina ciris*). (A few of these species also winter in south Florida and may have moved northward from there.) The implication is that some individuals fly across a small part of the western Atlantic. This theory receives some support from the records of many birds (but mostly of other species) in the western Atlantic in spring (Scholander, 1955).

Relationship to Adverse Weather.—The effect of a cold front, with or without rain, in precipitating trans-Gulf migrants is well known, but in my opinion the scarcity of migrants at other times has been overstated. Rain without a cold front precipitates many migrants; and, in fact, even under weather conditions ideal for continued overhead migration a few migrants are nearly always present along the coast. That these invariably are "hold-overs" from the last cold front seems improbable.

Systematic Account[1]

Explanation of Table 3.—In an effort to summarize the results of this study, evidence favoring each of the two migration routes is presented for 164 species in Table 3. (Data were too inconclusive for species omitted from the table.) Under the heading "Direct Observation," the number of records is given for each species seen over the Gulf ("Trans-Gulf") or flying around some part of the northern Gulf between Galveston Bay, Texas, and Apalachee Bay, Florida ("Circum-Gulf"). In the latter column the letter "w" indicates records of birds flying west and "e" those flying east. Under "Comparative Abundance" and "Sequence of Dates," the letter "x" (or, more doubtfully, "?") is used to symbolize the bulk of the migration.

COLYMBIFORMES AND PELECANIFORMES. The Pied-billed Grebe, a permanent resident over much of the study area, was a difficult subject, but there seems to be no evidence of a trans-Gulf migration. The same is true of the White Pelican and Anhinga. Significantly, all three species are unknown or are virtually so on the Dry Tortugas.

CICONIIFORMES. Most of the waders stick to the mainland in their migrations, but a few individuals of each species may venture across the Gulf. The Green Heron and Least Bittern (Figs. 3–6), however, appear to be chiefly trans-Gulf migrants, and perhaps the Yellow-crowned Night Heron is regularly, though not predominantly, so. All indications point to the exclusively circum-Gulf migration of the White Ibis (Figs. 7 and 8).

ANSERIFORMES. There is no conclusive evidence of trans-Gulf migration in any of the 16 species of ducks and geese included in this study. In fact, the winter ranges of most are largely within the United States and Mexico.

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[1]Scientific names of all species mentioned in this section may be found in Table 3.

Table 3

Summary of Evidence Pertinent to Migration Routes[1]

Species	Direct Observation		Comparative Abundance		Sequence of Dates	
	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf
Pied-billed Grebe (*Podilymbus podiceps*)	–	—	–	x	–	x
White Pelican (*Pelecanus erythrorhynchos*)	–	3w;1e	–	x	–	x
Anhinga (*Anhinga anhinga*)	–	—	–	x	–	?
Great Blue Heron (*Ardea herodias*)	2	1e	–	?	–	–
Common Egret (*Casmerodius albus*)	–	1e	–	?	–	–
Snowy Egret (*Leucophoyx thula*)	–	1e	–	?	–	–
Louisiana Heron (*Hydranassa tricolor*)	1	2e	–	?	–	–
Little Blue Heron (*Florida caerulea*)	–	3e	–	x	–	?
Green Heron (*Butorides virescens*)	1	—	x	?	?	–
Black-crowned Night Heron (*Nycticorax nycticorax*)	–	1e	–	?	–	–
Yellow-crowned Night Heron (*Nyctanassa violacea*)	1	—	–	–	?	–
American Bittern (*Botaurus lentiginosus*)	1	—	?	–	–	–
Least Bittern (*Ixobrychus exilis*)	2	—	x	–	x	–
White Ibis (*Eudocimus albus*)	–	3w;1e	–	x	–	x
Mallard (*Anas platyrhynchos*)	–	—	?	–	–	?
Gadwell (*Anas strepera*)	–	—	–	?	–	?
Pintail (*Anas acuta*)	–	—	–	?	–	x
Green-winged Teal (*Anas carolinensis*)	–	—	–	x	–	x
Blue-winged Teal (*Anas discors*)	–	3w;1e	–	x	–	x
American Widgeon (*Mareca americana*)	–	—	–	x	–	x
Shoveller (*Spatula clypeata*)	–	1e	–	x	–	x
Redhead (*Aythya americana*)	–	—	–	x	–	x
Ring-necked Duck (*Aythya collaris*)	–	—	–	x	–	?
Canvasback (*Aythya valisineria*)	–	—	–	?	–	?
Lesser Scaup (*Aythya affinis*)	–	1w	–	?	–	–
Ruddy Duck (*Oxyura jamaicensis*)	–	—	–	x	–	–
Turkey Vulture (*Cathartes aura*)	1	—	–	?	–	–
Swallow-tailed Kite (*Elanoides forficatus*)	–	—	–	–	–	x
Mississippi Kite (*Ictinia misisippiensis*)	–	—	–	–	–	–
Sharp-shinned Hawk (*Accipiter striatus*)	–	—	–	x	–	x
Cooper's Hawk (*Accipiter cooperii*)	–	—	–	?	–	x
Broad-winged Hawk (*Buteo platypterus*)	1	1e	?	?	–	x
Marsh Hawk (*Circus cyaneus*)	–	—	–	x	–	x
Osprey (*Pandion haliaetus*)	1	—	–	?	–	x
Peregrine Falcon (*Falco peregrinus*)	1	1w	–	?	?	?
Pigeon Hawk (*Falco columbarius*)	1	—	–	?	?	?
Sparrow Hawk (*Falco sparverius*)	2	—	?	–	–	–
Sora (*Porzana carolina*)	1	—	x	–	x	–
Purple Gallinule[2] (*Porphyrula martinica*)	1	—	–	x	?	?
American Coot (*Fulica americana*)	1	—	–	?	–	–
Semipalmated Plover (*Charadrius hiaticula*)	–	—	–	x	–	–
Wilson's Plover (*Charadrius wilsonia*)	–	—	–	x	–	x

(Continued on next page)

[1]Omitting species for which data are inadequate or inconclusive.
[2]The Florida Gallinule (**Gallinula chloropus**), omitted from this study, has also been found on the open Gulf (Bullis and Lincoln, 1952).

TABLE 3. — (Continued)

Species	Direct Observation		Comparative Abundance		Sequence of Dates	
	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf
Golden Plover (*Pluvialis dominica*)	–	—	x	–	?	–
Black-bellied Plover (*Squatarola squatarola*)	–	—	–	x	–	–
Ruddy Turnstone (*Arenaria interpres*)	–	—	–	x	–	–
Wilson's Snipe (*Capella gallinago*)	–	—	–	x	–	?
Long-billed Curlew (*Numenius americanus*)	1	—	–	?	–	–
Hudsonian Curlew (*Numenius hudsonicus*)	–	—	–	?	–	x
Upland Plover (*Bartramia longicauda*)	–	1w	x	–	x	–
Spotted Sandpiper (*Actitis macularia*)	–	—	x	x	x	–
Solitary Sandpiper (*Tringa solitaria*)	–	—	x	–	x	–
Willet (*Catoptrophorus semipalmatus*)	–	—	–	x	–	–
Greater Yellow-legs (*Totanus melanoleucus*)	–	—	–	?	–	–
Lesser Yellow-legs (*Totanus flavipes*)	–	—	–	?	–	–
American Knot (*Calidris canutus*)	–	—	–	?	–	x
Pectoral Sandpiper (*Erolia melanotos*)	–	—	x	–	x	–
White-rumped Sandpiper (*Erolia fuscicollis*)	–	—	?	–	?	?
Baird's Sandpiper (*Erolia bairdi*)	–	—	x	–	?	–
Least Sandpiper (*Erolia minutilla*)	1	—	–	x	–	–
Dowitchers (*Limnodromus griseus, L. scolopaceus*)	–	—	–	x	–	–
Stilt Sandpiper (*Micropalama himantopus*)	–	—	x	–	x	–
Semipalmated Sandpiper (*Ereunetes pusillus*)	1	1w	x	–	?	?
Western Sandpiper (*Ereunetes mauri*)	–	—	?	?	–	?
Buff-breasted Sandpiper (*Tryngites subruficollis*)	–	—	x	–	?	–
Marbled Godwit (*Limosa fedoa*)	–	—	–	?	–	–
Hudsonian Godwit (*Limosa haemastica*)	–	—	?	?	–	–
Sanderling (*Crocethia alba*)	–	—	?	–	–	–
Black-necked Stilt (*Himantopus mexicanus*)	–	—	?	?	?	?
Wilson's Phalarope (*Steganopus tricolor*)	–	—	?	?	–	?
Herring Gull (*Larus argentatus*)	2	—	x	–	–	–
Least Tern (*Sterna albifrons*)	–	—	–	?	–	?
Cabot's Tern (*Thalasseus sandvicensis*)	–	—	?	–	–	?
Black Tern (*Chlidonias niger*)	–	—	x	–	?	–
Mourning Dove (*Zenaidura macroura*)	3	—	?	?	–	–
Ground Dove (*Columbigallina passerina*)	–	1w	–	x	–	–
Yellow-billed Cuckoo (*Coccyzus americanus*)	1	—	x	–	x	–
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	–	—	x	–	x	–
Short-eared Owl (*Asio flammeus*)	–	—	–	x	–	x
Chuck-will's-widow (*Caprimulgus carolinensis*)	–	—	–	x	–	x
Common Nighthawk (*Chordeiles minor*)	3	—	x	?	x	x
Chimney Swift (*Chaetura pelagica*)	2	—	–	x	x	–
Ruby-throated Hummingbird (*Archilochus colubris*)	2	—	x	–	x	x
Belted Kingfisher (*Megaceryle alcyon*)	3	—	x	x	–	–
Yellow-bellied Sapsucker (*Sphyrapicus varius*)	–	—	x	–	x	x
Eastern Kingbird (*Tyrannus tyrannus*)	1	1e	x	–	x	–
Gray Kingbird (*Tyrannus dominicensis*)	1	—	–	x	–	x
Western Kingbird (*Tyrannus verticalis*)	–	—	?	–	–	?
Scissor-tailed Flycatcher (*Muscivora forficata*)	–	—	?	–	?	–
Crested Flycatcher (*Myiarchus crinitus*)	–	—	x	–	x	–
Eastern Phoebe (*Sayornis phoebe*)	1	—	–	–	–	?

(Continued on next page)

TABLE 3. — (Continued)

Species	Direct Observation		Comparative Abundance		Sequence of Dates	
	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf
Yellow-bellied Flycatcher (*Empidonax flaviventris*)	–	—	?	?	?	?
Acadian Flycatcher (*Empidonax virescens*)	–	—	x	–	x	–
Traill's Flycatcher (*Empidonax traillii*)	–	—	?	?	?	?
Least Flycatcher (*Empidonax minimus*)	–	—	x	–	x	–
Empidonax sp.?	–	—	–	x	–	–
Eastern Wood Pewee (*Contopus virens*)	–	—	x	–	x	–
Olive-sided Flycatcher[1] (*Nuttallornis borealis*)	1	—	?	?	–	?
Tree Swallow (*Iridoprocne bicolor*)	3	1w	–	x	–	x
Bank Swallow (*Riparia riparia*)	2	1e;1w	x	–	?	?
Rough-winged Swallow (*Stelgidopteryx ruficollis*)	–	1e	?	?	x	–
Barn Swallow (*Hirundo rustica*)	8	1e;1w	x	–	x	–
Cliff Swallow (*Petrochelidon pyrrhonota*)	2	1e;1w	–	x	–	x
Purple Martin (*Progne subis*)	2	2e	x	–	x	–
House Wren (*Troglodytes aedon*)	–	—	–	x	–	x
Catbird (*Dumetella carolinensis*)	1	—	x	–	x	–
American Robin (*Turdus migratorius*)	1	—	?	–	?	?
Wood Thrush (*Hylocichla mustelina*)	2	—	x	–	x	–
Hermit Thrush (*Hylocichla guttata*)	–	—	?	–	–	?
Olive-backed Thrush (*Hylocichla ustulata*)	1	—	x	–	x	–
Gray-checked Thrush (*Hylocichla minima*)	–	—	x	–	x	–
Veery (*Hylocichla fuscescens*)	2	—	x	–	x	–
Blue-gray Gnatchatcher (*Polioptila caerulea*)	–	—	–	?	–	x
Ruby-crowned Kinglet (*Regulus calendula*)	–	—	?	?	–	?
American Pipit (*Anthus spinoletta*)	–	—	?	?	?	–
Cedar Waxing (*Bombycilla cedrorum*)	–	—	x	–	?	–
White-eyed Vireo (*Vireo griseus*)	–	—	?	?	?	–
Bell's Vireo (*Vireo bellii*)	–	—	–	x	–	x
Yellow-throated Vireo (*Vireo flavifrons*)	–	—	x	–	?	?
Blue-headed Vireo (*Vireo solitarius*)	–	—	?	?	?	x
Red-eyed Vireo (*Vireo olivaceus*)	1	—	x	–	x	–
Philadelphia (*Vireo philadelphicus*)	–	—	?	–	?	–
Warbling Vireo (*Vireo gilvus*)	–	—	x	–	x	–
Black-and-white Warbler (*Mniotilta varia*)	4	1w	x	x	x	–
Prothonotary Warbler (*Protonotaria citrea*)	4	—	x	–	x	–
Swainson's Warbler (*Limnothlypis swainsonii*)	–	—	x	–	?	?
Worm-eating Warbler (*Helmitheros vermivorus*)	4	1w	x	?	x	–
Golden-winged Warbler (*Vermivora chrysoptera*)	1	—	?	?	x	–
Blue-winged Warbler (*Vermivora pinus*)	–	—	?	?	x	–
Bachman's Warbler (*Vermivora bachmanii*)	–	—	–	–	x	–
Tennessee Warbler (*Vermivora peregrina*)	–	—	x	–	x	–
Orange-crowned Warbler (*Vermivora celata*)	–	—	?	?	–	x
Nashville Warbler (*Vermivora ruficapilla*)	1	—	–	x	x	–
Parula Warbler (*Parula americana*)	4	1w	x	–	x	x
Yellow Warbler (*Dendroica petechia*)	3	1e;1w	x	?	x	–
Magnolia Warbler (*Dendroica magnolia*)	2	—	x	?	?	?
Cape May Warbler (*Dendroica tigrina*)	4	—	–	x	–	x

(Continued on next page)

[1]The Vermilion Flycatcher (**Pyrocephalus rubinus**), omitted from this study, has once been found on the open Gulf (Bullis and Lincoln, 1952).

TABLE 3. — (Continued)

Species	Direct Observation		Comparative Abundance		Sequence of Dates	
	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf	Trans-Gulf	Circum-Gulf
Black-throated Blue Warbler (*Dendroica caerulescens*)	1	—	–	x	x	?
Myrtle Warbler (*Dendroica coronata*)	6	1w	x	–	x	x
Black-throated Green Warbler (*Dendroica virens*)	1	—	–	x	?	?
Cerulean Warbler (*Dendroica cerulea*)	1	—	x	–	x	–
Blackburnian Warbler (*Dendroica fusca*)	–	—	x	?	x	–
Yellow-throated Warbler (*Dendroica dominica*)	1	—	x	–	x	x
Chestnut-sided Warbler (*Dendroica pensylvanica*)	1	—	x	–	x	–
Bay-breasted Warbler (*Dendroica castanea*)	1	—	x	–	x	–
Black-poll Warbler (*Dendroica striata*)	2	—	–	x	x	–
Prairie Warbler (*Dendroica discolor*)	–	—	–	x	?	x
Palm Warbler (*Dendroica palmarum*)	1	—	–	x	–	x
Ovenbird (*Seiurus aurocapillus*)	1	—	x	–	x	–
Northern Water-thrush (*Seiurus noveboracensis*)	1	—	x	–	–	x
Louisiana Water-thrush (*Seiurus motacilla*)	2	—	x	–	x	–
Kentucky Warbler (*Oporornis formosus*)	4	—	x	–	x	–
Mourning Warbler (*Oporornis philadelphia*)	1	—	–	x	x	–
Yellow-throat (*Geothlypis trichas*)	4	—	–	x	–	–
Yellow-breasted Chat (*Icteria virens*)	–	—	?	x	–	x
Hooded Warbler (*Wilsonia citrina*)	2	—	x	–	x	–
Wilson's Warbler (*Wilsonia pusilla*)	1	—	?	x	–	–
Canada Warbler (*Wilsonia canadensis*)	–	—	–	x	–	x
American Redstart (*Setophaga ruticilla*)	8	1w	x	x	x	–
Bobolink (*Dolichonyx oryzivorus*)	3	—	x	x	?	?
Orchard Oriole (*Icterus spurius*)	5	—	x	–	x	–
Baltimore Oriole (*Icterus galbula*)	2	—	x	–	x	x
Scarlet Tanager (*Piranga olivacea*)	3	—	x	–	x	x
Summer Tanager (*Piranga rubra*)	3	—	x	–	x	x
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)	–	—	x	–	x	x
Blue Grosbeak (*Guiraca caerulea*)	–	—	x	?	x	–
Indigo Bunting (*Passerina cyanea*)	3	1e	x	?	x	–
Painted Bunting (*Passerina ciris*)	1	—	x	?	x	–
Dickcissel (*Spiza americana*)	1	—	x	?	x	x
Savannah Sparrow (*Passerculus sandwichensis*)	–	—	?	x	–	x
Grasshopper Sparrow (*Ammodramus savannarum*)	1	—	–	x	–	x
Lincoln's Sparrow (*Melospiza lincolnii*)	–	—	–	x	–	x

FALCONIFORMES. Turkey Vultures move northward along the Texas and Florida coasts to some extent in spring. Although there seems to be no record of any far from land, Van Tyne and Trautman (1945) witnessed what appeared to be the beginning of a trans-Gulf migration. Swallow-tailed Kites are seldom encountered south of their breeding grounds, but the few migration records are all from land areas. It seems almost certain that the Mississippi Kite follows the coast from Veracruz through Texas in reaching its breeding grounds. Whether the same is true of the Broad-winged Hawk is much less certain, as comparatively few have been reported in Mexico and one was recorded off the Louisiana coast (Figs. 9 and 10). It seems probable that most cross

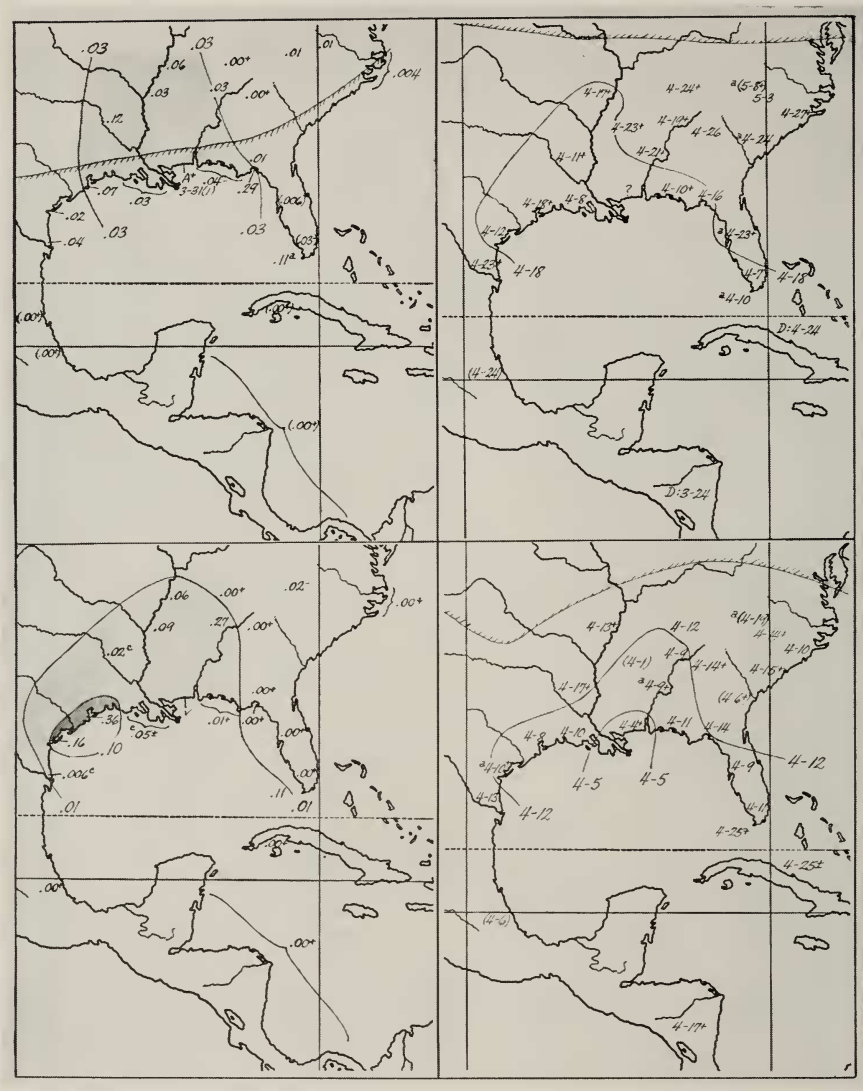

FIG. 11 (upper left) Comparative Abundance and FIG. 12 (upper right) Median Dates for the Sora.

FIG. 13 (lower left) Comparative Abundance and FIG. 14 (lower right) Median Dates for the Upland Plover.

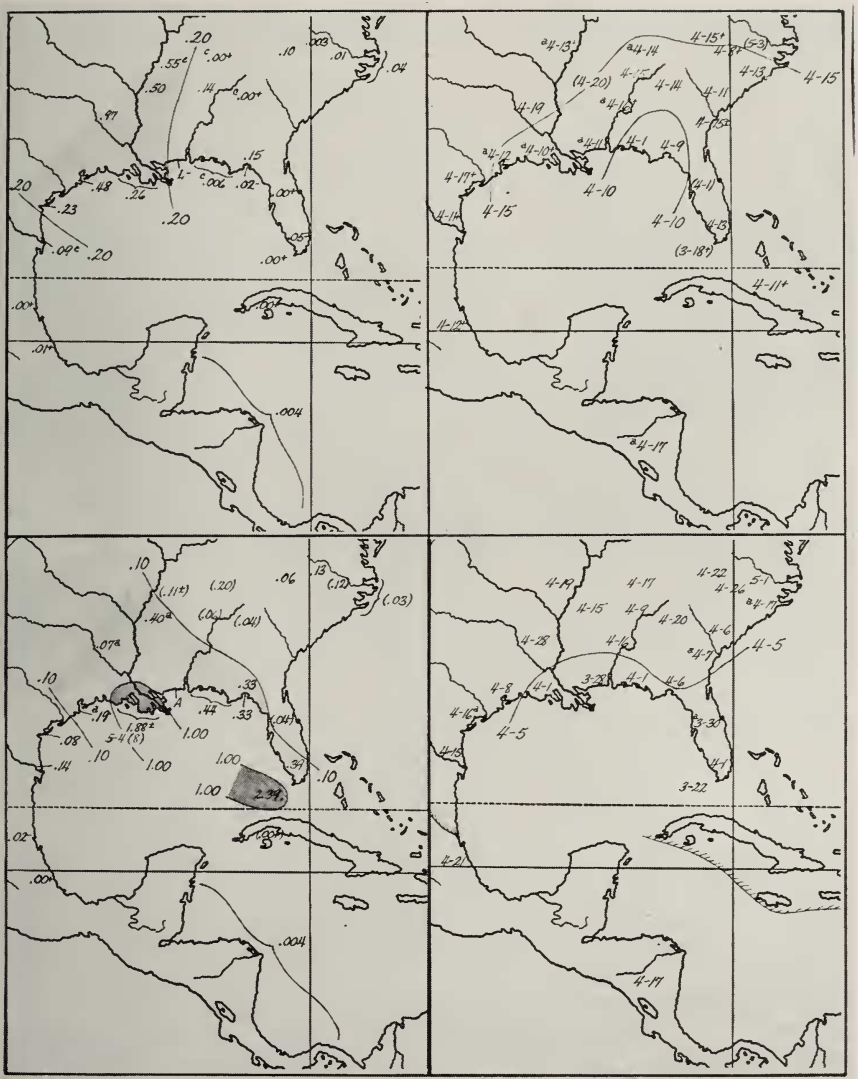

FIG. 15 (upper left) Comparative Abundance and FIG. 16 (upper right) Median Dates for the Pectoral Sandpiper.

FIG. 17 (lower left) Comparative Abundance and FIG. 18 (lower right) Arrival Dates for the Yellow-billed Cuckoo.

from Yucatan to the Texas coast, then turn northward and northeastward. Sharp-shinned and Cooper's hawks follow coastal and inland routes in spring. Marsh Hawks probably do the same, but I would not rule out the likelihood of an occasional individual's crossing the Gulf. Despite my observation on the Tortugas, there is nothing to indicate a regular trans-Gulf flight of Ospreys in spring. Falcons are well known for their coastwise migrations, but each of the three eastern species has been observed on the Gulf one time, and it is not unlikely that a few of these strong flyers make the long flight across.

RALLIDAE. Pertinent data on the Virginia and Black rails are too meagre to be indicative, but there is abundant circumstantial evidence that the Sora crosses the Gulf with regularity (Figs. 11 and 12). This is also true of the Purple Gallinule, which arrives earlier on the northern Gulf than on the Texas coast. Despite the general abundance of the species, only one Coot has been found on the open Gulf and it is only a few miles offshore. Apparently few or none cross the Gulf of Mexico.

CHARADRIIDAE. Piping and Snowy plovers are shore birds of comparatively northerly winter ranges, and presumably few individuals which breed in the United States winter south of the Gulf. There is no reason to doubt that they follow the coast lines in the manner of most shore birds. Quantitative data indicate that most Semipalmated Plovers do also, and there is no record of one far offshore. Wilson's and Black-bellied plovers and the Ruddy Turnstone are more common on the east and west sides of the Gulf, and Wilson's usually arrives there earlier in spring; but each species was encountered much less frequently in Mexico. Comparatively few Killdeer winter south of the Gulf of Mexico, and there is no indication that these cross the Gulf in spring. Golden Plovers must, however, be regarded as trans-Gulf migrants, as significant numbers have not been reported from eastern Mexico. The highest coastal frequencies by far are in Texas and Louisiana.

SCOLOPACIDAE. Most members of this group were more common on the eastern or western Gulf, but values in Mexico were usually low. This was true of Wilson's Snipe, but I believe that the few, out-of-place individuals found on the northern Gulf coast in late spring have flown across. Despite the fact that the Long-billed Curlew is most common in spring on the Texas coast, a record of seven off the Louisiana coast (Lowery, 1946) denotes a Gulf crossing for some. Most Hudsonian Curlews follow coastal routes within the United States, but Mexican records are few at this date. Both the quantitative data and the sequence of migration dates imply a trans-Gulf passage for the Upland Plover, most individuals reaching land in Texas or Louisiana (Figs. 13 and 14). There are, almost surely, important migrations of Spotted Sandpipers both around and across the Gulf. The bulk of the Solitary Sandpipers crosses the Gulf west of the Dry Tortugas, where the species has not been recorded in spring; smaller numbers apparently follow each side of the Gulf northward. Pectoral (Figs. 15 and 16), White-rumped, Baird's, and Buff-breasted sandpipers appear to be trans-Gulf migrants most common on the Texas coast (and Louisiana, in the case of the Pectoral). The Stilt Sandpiper may fall into this category in spite of its wide winter range in Mexico. The Hudsonian Godwit is too rare to appraise at this time, and the Marbled Godwit is often as common in winter as in spring. A large-scale trans-Gulf migration for the remaining members of this family seems improbable, but reliable migration dates were unobtainable on the Gulf for such non-breeding permanent residents as the Dowitchers, Sanderling, and most of the "peeps." There are, however, direct observations both of trans-Gulf and circum-Gulf migration in the Semipalmated Sandpiper.

RECURVIROSTRIDAE AND PHALAROPODIDAE. The Black-necked Stilt is temporarily classified as a chiefly trans-Gulf migrant to the coast of Texas and Louisiana. Until evidence of

numbers is forthcoming from Mexico, Wilson's Phalarope must also be reckoned a trans-Gulf migrant even though the center of spring abundance is the *southern* coast of Texas.

LARIDAE. The resident habits of the gulls render them difficult subjects for this study, but there are indications that some Herring Gulls cross the Gulf of Mexico in spring. Because of the difficulties of distinguishing them in the field, Forster's and Common terns have yielded little data of value in this study. Least Terns, unrecorded far offshore in the Gulf, reach the Texas and Florida coasts earlier than the northern Gulf, and hence are primarily circum-Gulf in their spring migration. The same route seems to be followed by other species of terns with the striking exception of the Black Tern, which, for all its abundance on the Texas coast, seems to be entirely lacking in spring in Mexico.

COLUMBIDAE. Although the two common species of doves are resident in most parts of the South, three Mourning Dove records on the Gulf provide direct evidence of the trans-Gulf flight of this species. It appears likely that most of the White-winged Doves appearing in Texas in spring have moved northward from Mexico.

CUCULIDAE. Large numbers of Yellow-billed Cuckoos cross the Antilles (?), Florida Keys, and Gulf of Mexico in spring, the greatest numbers precipitating on or passing over the Louisiana coast (Figs. 17 and 18). Black-billed Cuckoos cross on a more westerly course, appearing in eastern Mexico almost as frequently as from Texas to Alabama.

CAPRIMULGIDAE. All evidence suggests a heavy migration of Chuck-will's-widows northward on the Florida Peninsula, but whether all of those breeding north of the Gulf arrive from this route is doubtful. Data on the Whip-poor-will were inconclusive, but there is every indication that Common Nighthawks arrive almost simultaneously and occur in comparable numbers all around the Gulf in the United States, some having been seen arriving from over the Gulf (F. M. Weston, *fide* Lowery, 1946) (Figs. 19 and 20). By contrast, Mexican records are few in spring and the numbers negligible.

APODIFORMES. Chimney Swifts apparently migrate on a wide front, but the largest coastal numbers appear in Texas. I have seen one arriving from over the Gulf and believe that many follow this course, although Loetscher (1955) describes an important migration along the eastern coast of Mexico. The Ruby-throated Hummingbird, long cited as a trans-Gulf migrant, is uncommon in most of Florida and apparently rather rare in Mexico, but occurs in large numbers on the Dry Tortugas and the coasts of Louisiana and Texas.

ALCEDINIDAE AND PICIDAE. Two records of the Belted Kingfisher on the Gulf of Mexico, along with a high spring frequency on the Louisiana coast, point to the trans-Gulf course followed by some individuals. Although the high frequencies of the Yellow-bellied Sapsucker on the northern Gulf coast may merely reflect its status there in winter, late individuals appearing there after the winter population has departed probably come from across the Gulf, some of them from the West Indies *via* the Dry Tortugas. The Red-headed Woodpecker (*Melanerpes erythrocephalus*), not included in this study because it is not known to winter south of the United States, occurs as a summer resident on islands off the Mississippi coast (Burleigh, 1944) and as a spring transient on Gulf islands off Florida (including a June record for the Tortugas; Howell, 1932).

TYRANNIDAE. The Eastern Kingbird has been cited (Williams, 1945) as a circum-Gulf migrant, and does appear to be unusually common on parts of the Texas coast. The lack of large numbers in Mexico, however, coupled with the earlier migration dates on

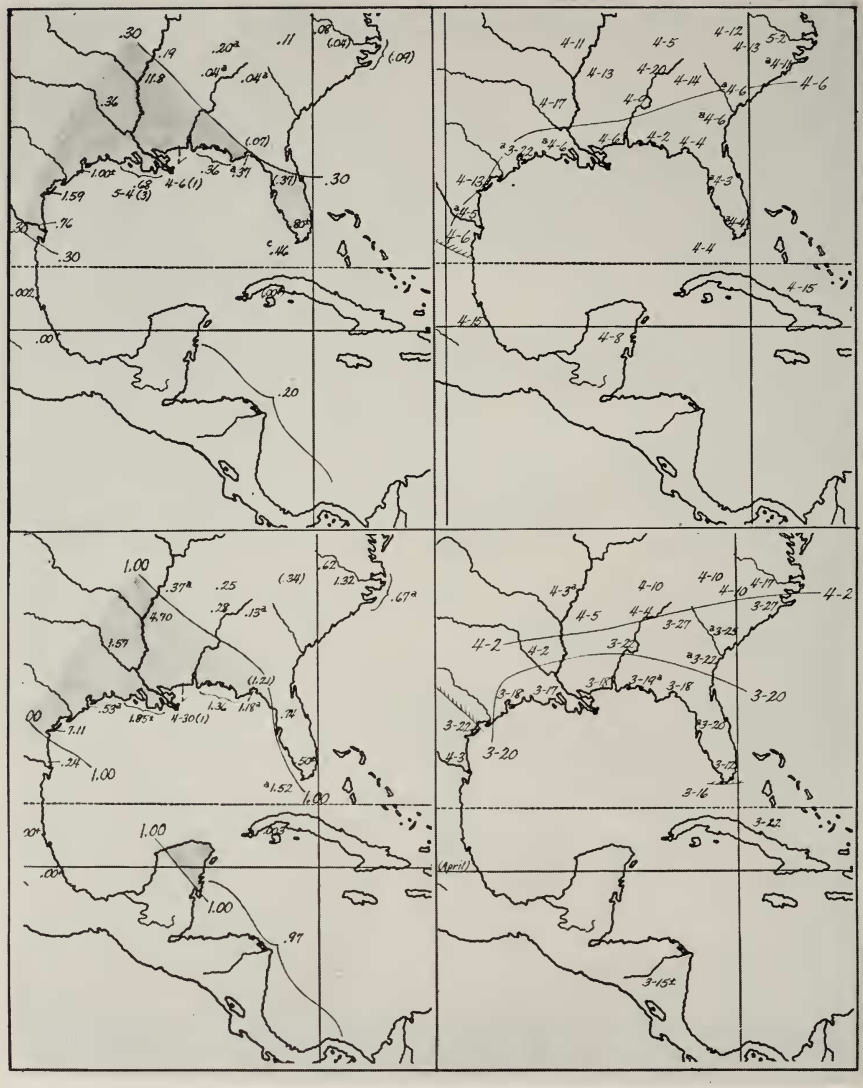

Fig. 19 (upper left) Comparative Abundance and Fig. 20 (upper right) Arrival Dates for the Common Nighthawk.

Fig. 21 (lower left) Comparative Abundance and Fig. 22 (lower right) Arrival Dates for the Eastern Kingbird.

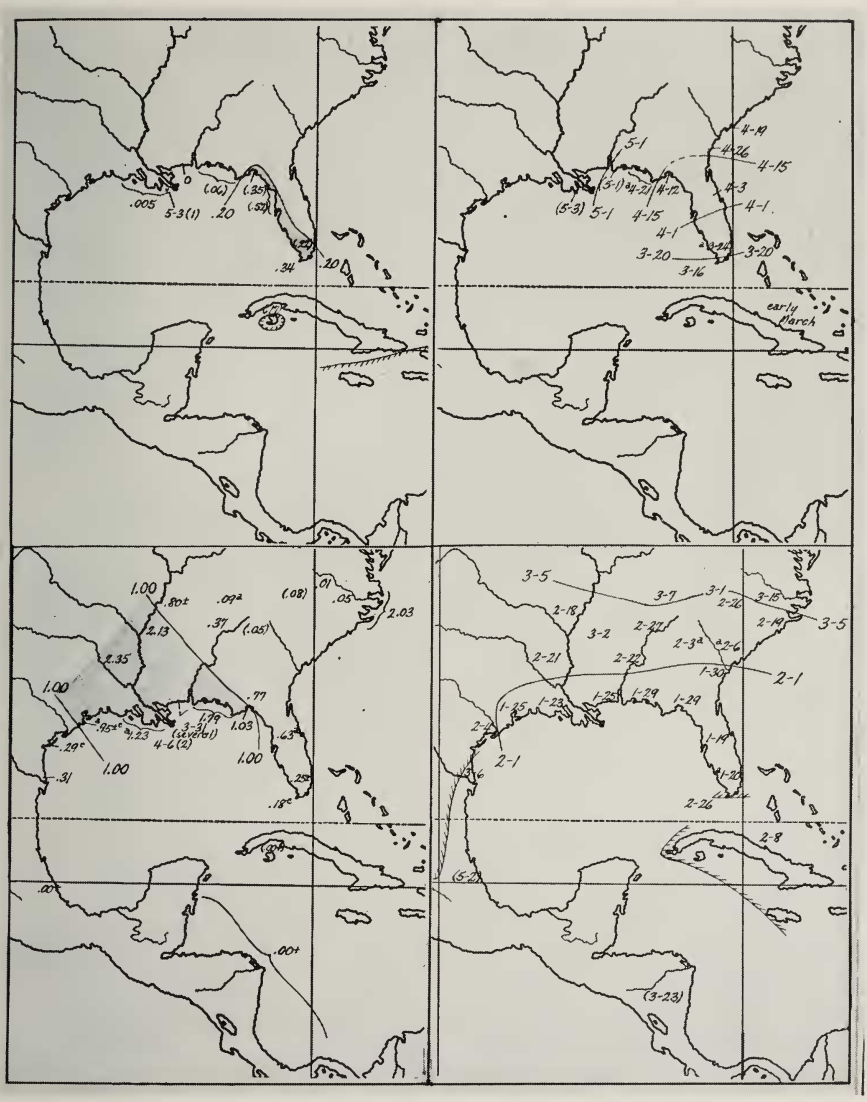

Fig. 23 (upper left) Comparative Abundance and Fig. 24 (upper right) Arrival Dates for the Gray Kingbird.

Fig. 25 (lower left) Comparative Abundance and Fig. 26 (lower right) Arrival Dates for the Purple Martin.

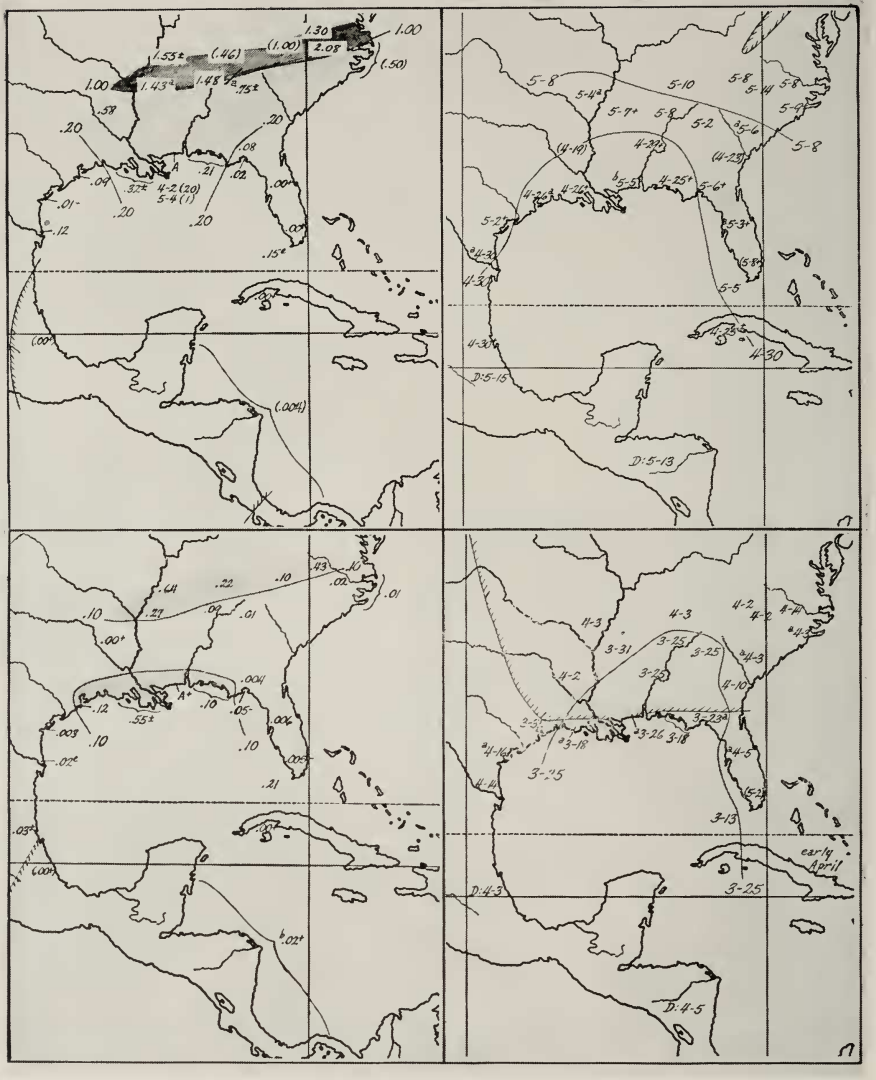

Fig. 27 (upper left) Comparative Abundance and Fig. 28 (*lower* right) Arrival Dates for the Wood Thrush.

Fig. 29 (lower left) Comparative Abundance and Fig. 30 (*upper* right) Median Dates for the Olive-backed Thrush.

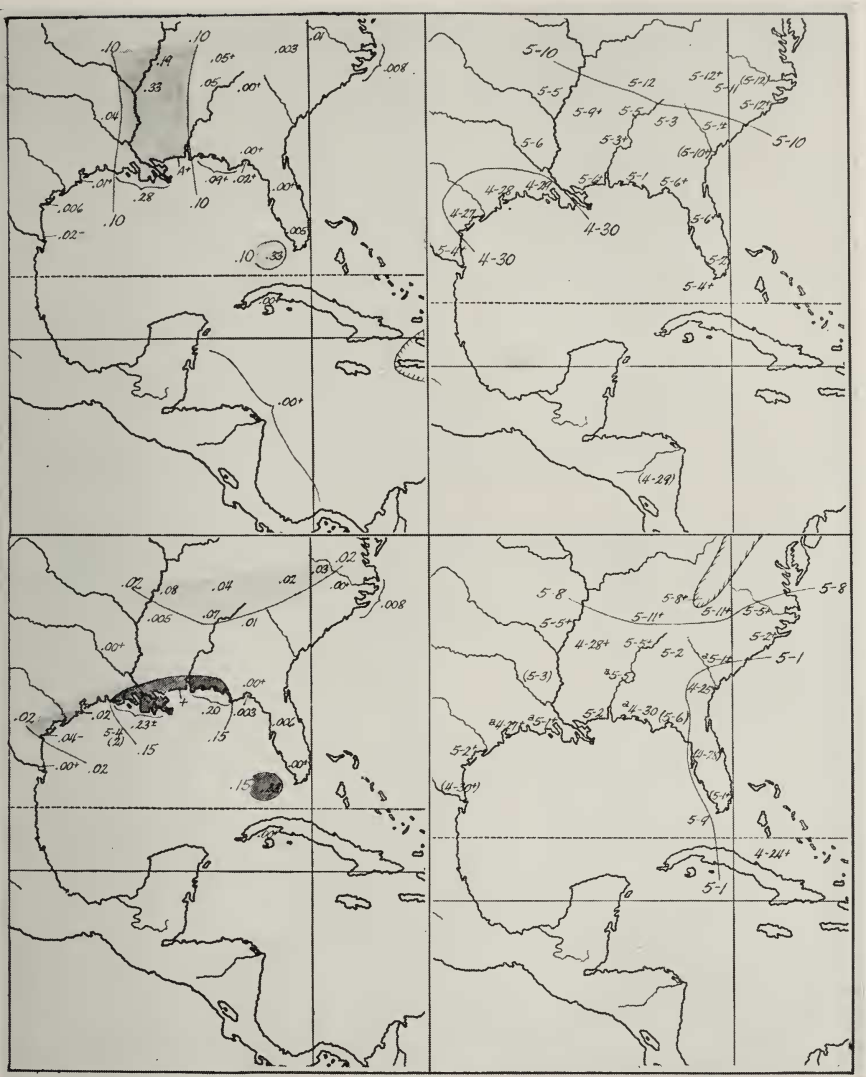

FIG. 31 (upper left) Comparative Abundance and FIG. 32 (upper right) Median Dates for the Gray-cheeked Thrush.

FIG. 33 (lower left) Comparative Abundance and FIG. 34 (lower right) Median Dates for the Veery.

the northern Gulf coast convince me that the chief migration route is across the western Gulf (Figs. 21 and 22). On the contrary, the occurrence of a Gray Kingbird over the Gulf of Mexico (Lowery, 1946) is considered most unusual (Figs. 23 and 24). At present there is no evidence of Gulf-crossing for the Western Kingbird or Scissor-tailed Flycatcher, but it may be expected occasionally. Despite its seeming absence from the Dry Tortugas, the Crested Flycatcher must be considered a trans-Gulf migrant, arriving early on the northern Gulf and being most common in spring from northern Florida to the Mississippi coast. Although there is a spring record of the Eastern Phoebe off the Louisiana coast, its scarcity south of the Gulf in winter makes this occurrence appear unusual. Members of the genus *Empidonax*, difficult to separate in the field, are quite common in spring in eastern Mexico and southern Texas. A record of one on the Gulf, however, as well as early arrival dates of the Acadian and Least flycatchers on the northern Gulf coast, demonstrates that a trans-Gulf passage of these small birds may not be unusual. Two species of pewees occur in spring in eastern Mexico and southern Texas, and identification of silent birds is impossible without collecting. Nevertheless, the highest frequencies and the earliest records are along the northern Gulf coast, leading to the belief that the Eastern Wood Pewee is chiefly a trans-Gulf migrant. Not enough data are available for the Olive-sided Flycatcher to be indicative.

HIRUNDINIDAE. Although the major flight of Tree Swallows passes along the sides of the Gulf, the data suggest that at least a few cross it in spring. Bank Swallows are both trans-Gulf and circum-Gulf migrants, the greatest numbers occurring on the Texas and Louisiana coasts. Early arrival dates show the Rough-winged Swallow to cross the Gulf regularly, although none has been reported offshore; also the numbers reported in eastern Mexico have been comparatively small. Even though Barn Swallows follow parts of the coastline in great numbers, the following facts persuade me that a major flight crosses the Gulf: earliest median dates in Texas and Louisiana; frequencies on the Texas coast several times as high as those in eastern Mexico; at least eight spring records involving hundreds of individuals on the open Gulf. Data for the Cliff Swallow are similar to those for the Barn Swallow, except that there is a progression of migration dates around the Texas and Louisiana coasts; therefore it is probable that most individuals follow at least this part of the coastline, but a few precocious migrants have been seen offshore from Louisiana to Alabama. All three lines of evidence favor the theory that Purple Martins are Gulf-crossing migrants (Figs. 25 and 26).

TROGLODYTIDAE AND MIMIDAE. There is no evidence of a trans-Gulf migration of House Wrens, and their northerly winter range would not suggest such a probability. The two heaviest flights of Catbirds are across the Gulf and northward on the Florida Peninsula, with a fair migration also through eastern Mexico.

TURDIDAE. Members of this family are among the most typical of the trans-Gulf migrants, although the northerly winter ranges of the Robin and Hermit Thrush militate against their total contribution to this phenomenon. The Wood, Olive-backed, and Gray-checked thrushes, and the Veery are much more numerous in spring on the Dry Tortugas and the northern Gulf than in peninsular Florida, Texas, or eastern Mexico; this evidence is fully backed by the sequence of migration dates and by sight records of three of these species on the open Gulf (Figs. 27–34).

SYLVIIDAE. Frequencies of the Blue-gray Gnatcatcher are too irregular to be of value in this study, but the progression of arrival dates implies only circum-Gulf migration. Essentially the same situation holds for the Ruby-crowned Kinglet, which is probably rare south of the Gulf of Mexico even in winter.

MOTACILLIDAE AND BOMBYCILLIDAE. Although there is little *prima facie* evidence for Gulf-crossing in the American Pipit, it is unlikely that the occasional individuals seen on the northern Gulf coast in early May have circled part of the Gulf or lingered so far past the species' normal departure date. Similarly, I am suspicious of large flocks of Cedar Waxwings seen on the northern Gulf coast in spring where they have been chiefly absent in winter.

VIREONIDAE. The White-eyed Vireo is a difficult subject due to its extensive winter and summer ranges, but early arrival dates on the northern Gulf coast suggest that a part of the migration comes across that body of water. Earliest records of Bell's Vireo also extend northeastward from Corpus Christi, Texas, although there is certainly an important migration through eastern Mexico. Yellow-throated Vireos have proven more common in spring along the Gulf from northern Florida to Galveston Bay than farther south, even though most of the former area lies south of its breeding range. It is very likely that there are smaller migrations along the Texas coast and Florida Peninsula. My data on the Blue-headed Vireo are inconclusive, but the Red-eyed Vireo is, without doubt, chiefly a trans-Gulf migrant (Figs. 35 and 36). The Philadelphia Vireo migrates across the Gulf mostly to the Texas coast, and the Warbling Vireo is about equally frequent there and in Louisiana. Probably a few individuals of the latter species follow the coast northward from Mexico.

PARULIDAE. Records of birds on the Gulf and early median dates in Mississippi and Louisiana are signs of a trans-Gulf migration of the Black and White Warbler. Comparative frequencies, however, show the migration on both sides of the Gulf to be just as important. The absence of the Prothonotary Warbler in eastern Mexico and its scarcity in the southern Florida Peninsula leave no room for doubt that it migrates chiefly across the Gulf, as has long been claimed. The sequence of arrival dates and records over the Gulf complete the evidence (Figs. 37 and 38). Present evidence favors the same view for Swainson's Warbler, although it is so rare at some places on the northern Gulf coast that the significance of quantitative data are open to question. The trans-Gulf and circum-Gulf highways are utilized about equally by the Worm-eating Warbler, but the Golden-winged and Blue-winged warblers evidently cross from Central America to Texas and Louisiana in greatest numbers. Early spring records of Bachman's Warbler in Louisiana and Mississippi suggest a direct flight from Cuba, but data are too scarce to be conclusive. Most Tennessee Warblers fly directly from their winter home to (or beyond) the shoreline stretching from Texas to Alabama, but a smaller migration passes through eastern Mexico (Figs. 39 and 40). It does not appear geographically probable that many Orange-crowned Warblers would cross the Gulf of Mexico in spring, nor is there direct evidence that they do so. Most Nashville Warblers reach the Texas coast from eastern Mexico, but a few apparently take a short cut from Yucatan to points as far east as Louisiana. Although the major migration of Parula Warblers passes through the Florida Peninsula, many individuals cross from Yucatan (and Cuba?) to the northern Gulf as far west as Galveston Bay. The principal migration routes of the Yellow Warbler extend up the Mexican-Texas coast and across the western Gulf. The statement that it is "less numerous in spring" than in fall in Florida (Howell, 1932) is extremely conservative, as it is decidedly rare in the Peninsula at that season. The case of the Magnolia Warbler is similar, but it is even scarcer in Florida. Notwithstanding the fact that the Cape May Warbler is a regular transient in peninsular Florida, it appears that a fairly important part of its spring flight carries northwestward across southern Florida and the eastern Gulf to northwestern Florida, coastal Alabama, and inland localities. This helps to explain the presence of a few on the open Gulf

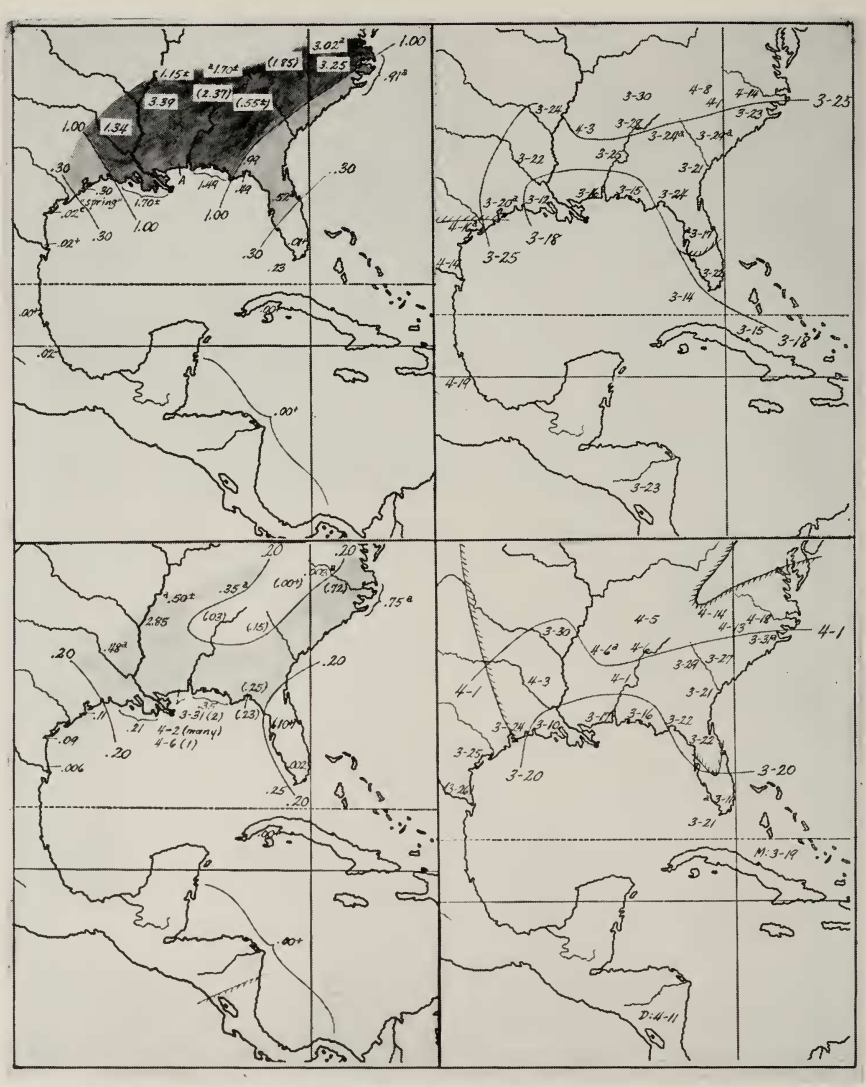

Fig. 35 (upper left) Comparative Abundance and Fig. 36 (upper right) Arrival Dates for the Red-eyed Vireo.

Fig. 37 (lower left) Comparative Abundance and Fig. 38 (lower right) Arrival Dates of the Prothonotary Warbler.

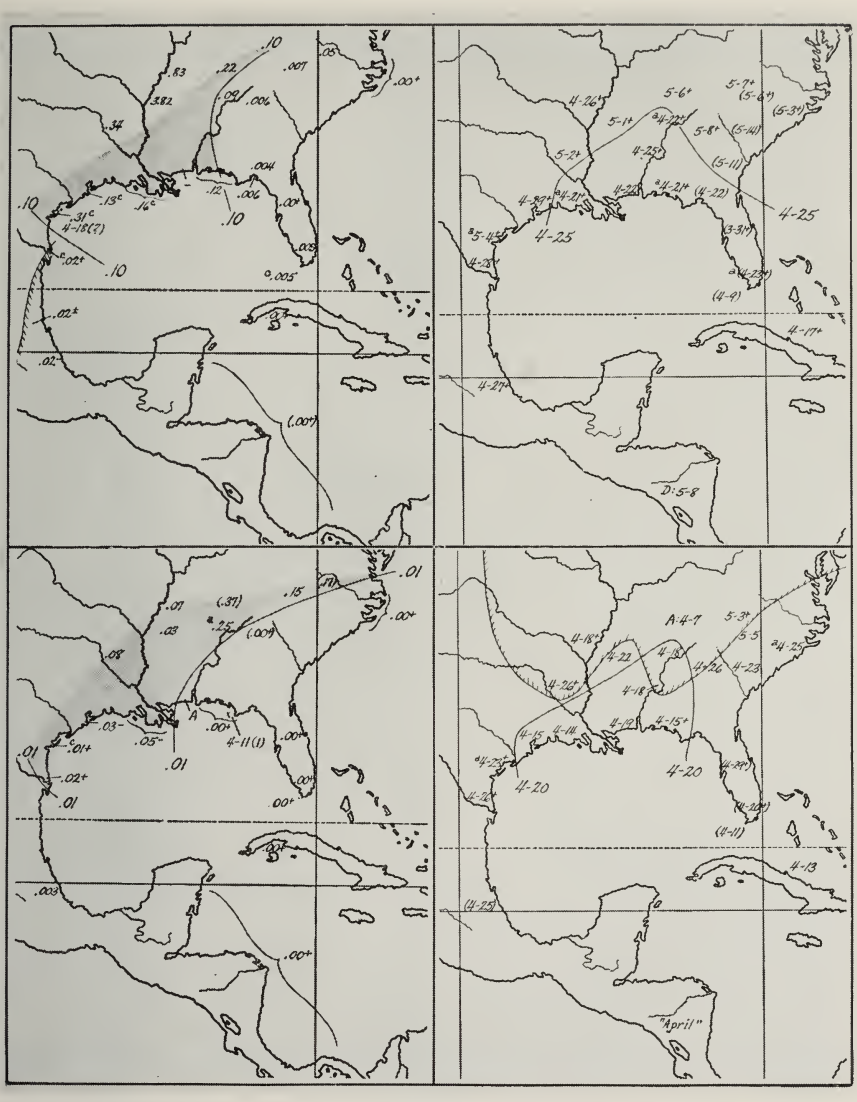

Fig. 39 (upper left) Comparative Abundance and Fig. 40 (upper right) Median Dates for the Tennessee Warbler.

Fig. 41 (lower left) Comparative Abundance and Fig. 42 (lower right) Median Dates for the Cerulean Warbler.

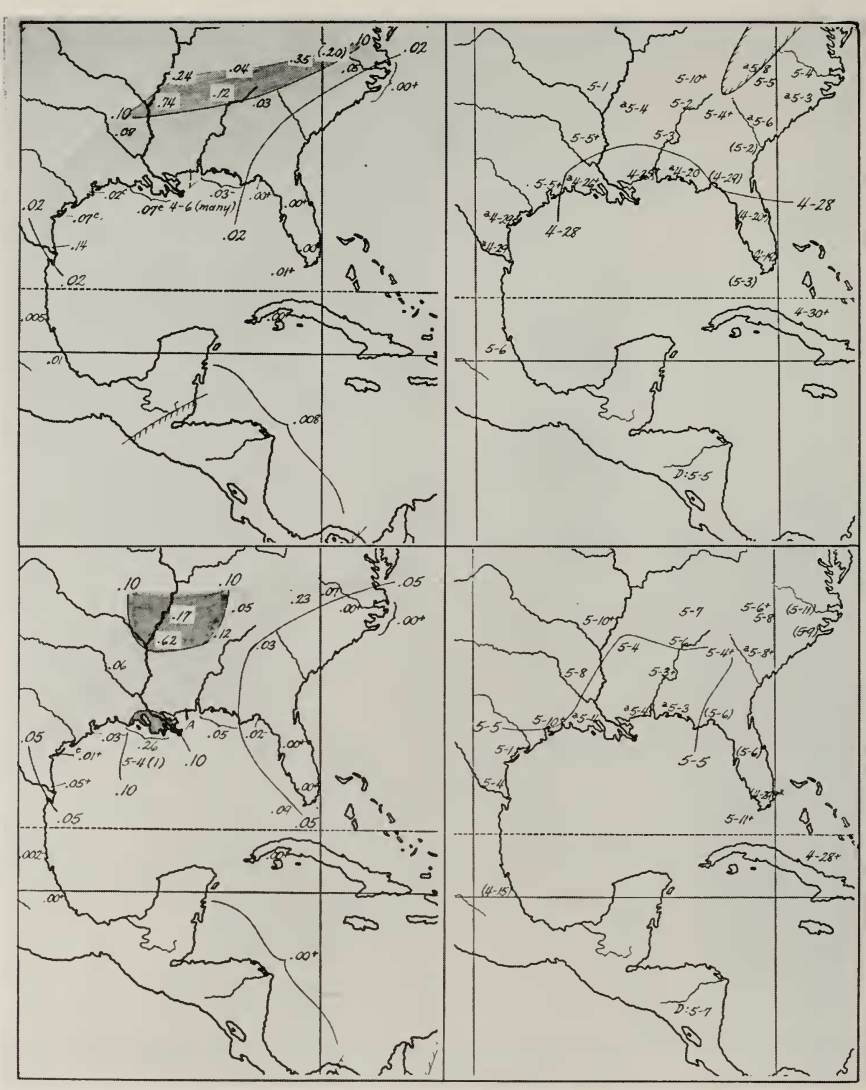

Fig. 43 (upper left) Comparative Abundance and Fig. 44 (upper right) Median Dates for the Chestnut-sided Warbler.

Fig. 45 (lower left) Comparative Abundance and Fig. 46 (lower right) Median Dates for the Bay-breasted Warbler. .

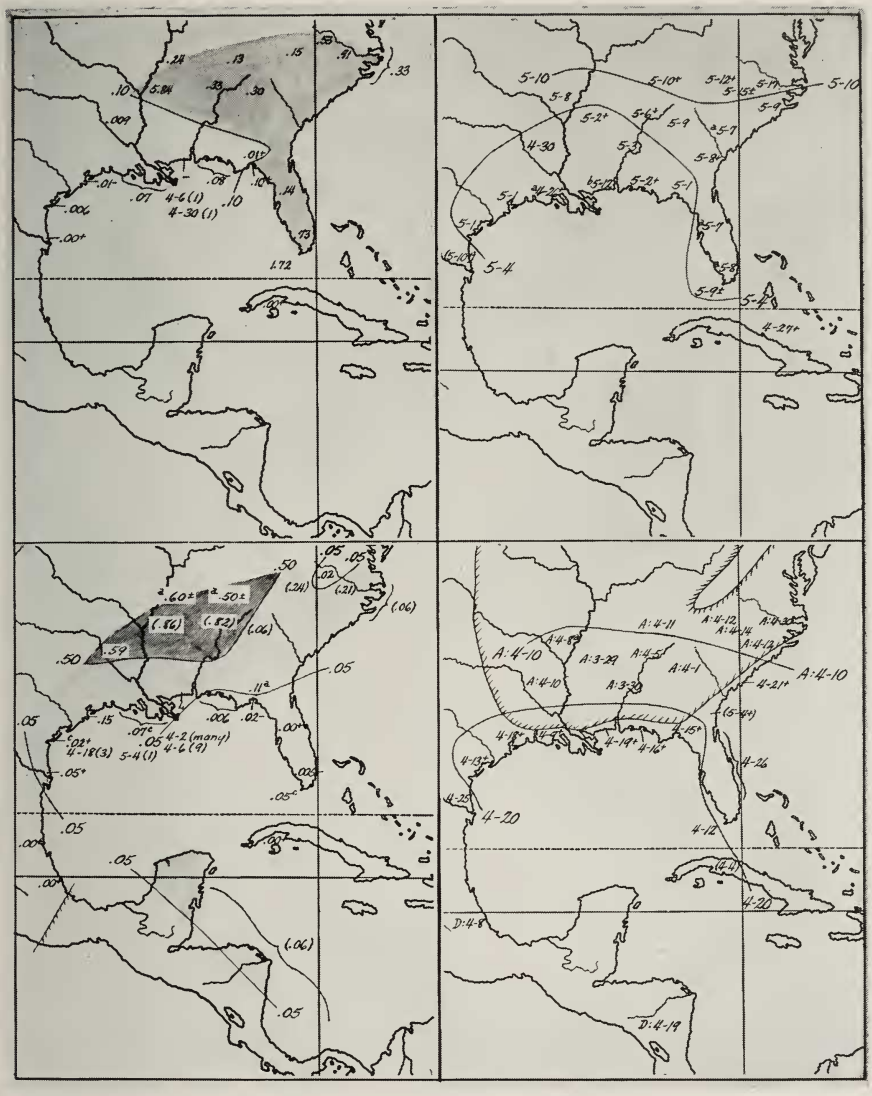

Fig. 47 (upper left) Comparative Abundance and Fig. 48 (upper right) Median Dates of the Black-poll Warbler.

Fig. 49 (lower left) Comparative Abundance and Fig. 50 (lower right) Median Dates for the Kentucky Warbler.

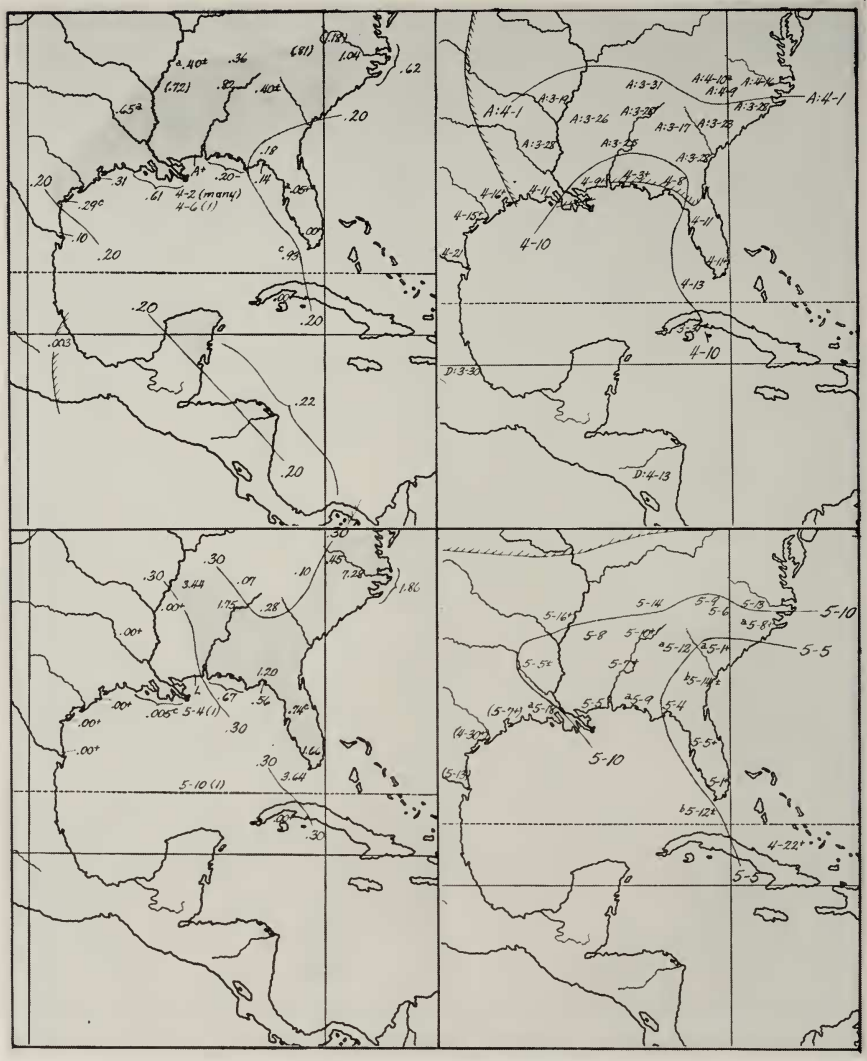

Fig. 51 (upper left) Comparative Abundance and Fig. 52 (upper right) Median Dates for the Hooded Warbler.

Fig. 53 (lower left) Comparative Abundance and Fig. 54 (lower right) Median Dates for the Bobolink.

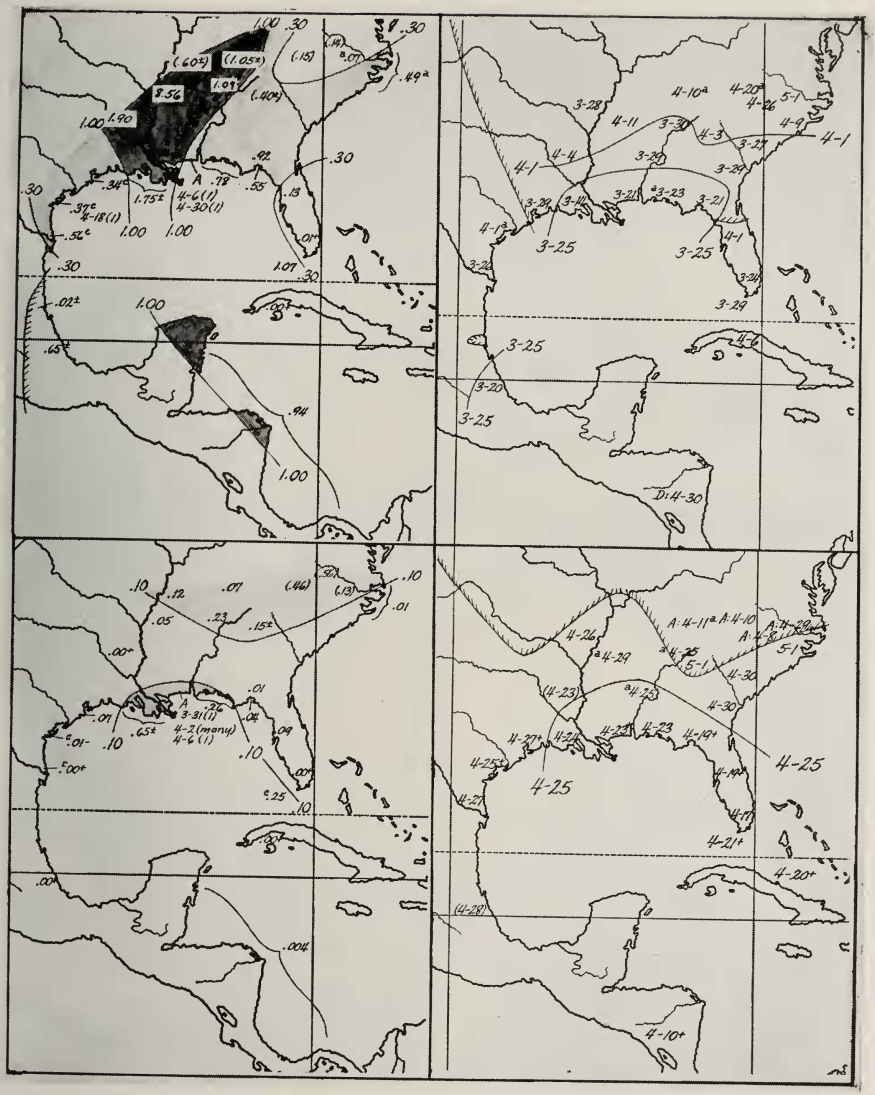

Fig. 55 (upper left) Comparative Abundance and Fig. 56 (upper right) Arrival Dates for the Orchard Oriole.

Fig. 57 (lower left) Comparative Abundance and Fig. 58 (lower right) Median Dates for the Scarlet Tanager.

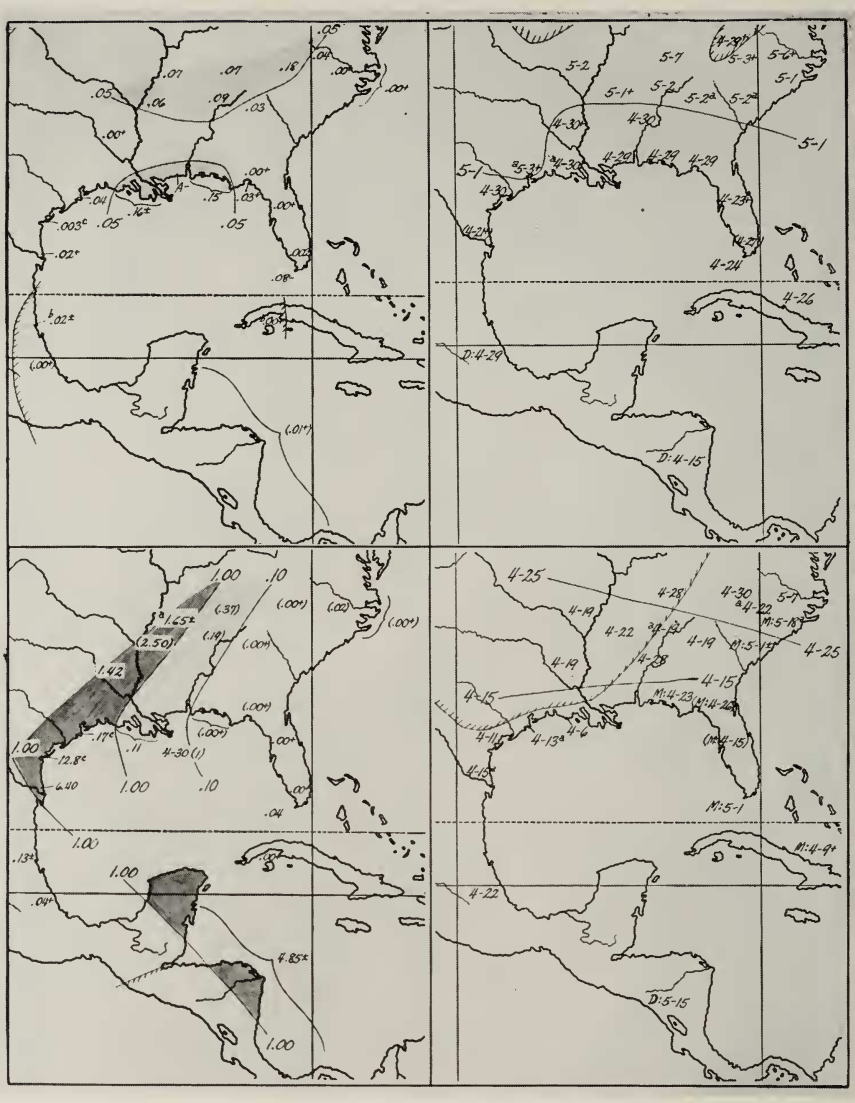

Fig. 59 (upper left) Comparative Abundance and Fig. 60 (upper right) Median Dates for the Rose-breasted Grosbeak.

Fig. 61 (lower left) Comparative Abundance and Fig. 62 (lower right) Arrival Dates for the Dickcissel.

(Lowery and Newman, 1954). The migration of the Black-throated Blue Warbler is much more nearly confined to the Florida Peninsula, very few venturing across the Gulf. Conclusive evidence on the commonly-wintering Myrtle Warbler is difficult to obtain, but its quantitative distribution in spring and records on the Gulf denote trans-Gulf flights with an occasional straggler near the middle of May. The Black-throated Green Warbler may be the only eastern member of its genus to migrate chiefly through eastern Mexico, but a few also cross the Gulf in spring. Cerulean (Figs. 41 and 42) and Blackburnian warblers precipitate on the Texas and Louisiana coasts, only small numbers occurring in eastern Mexico; their median dates are also earlier on the northern Gulf coast. Early arrivals on the northern Gulf and a record 60 miles off the Louisiana coast (Bullis and Lincoln, 1952) signify a trans-Gulf passage for the Yellow-throated Warbler, but it is possible that migrations through Mexico and the Florida Peninsula are equally heavy. The trans-Gulf migration of Chestnut-sided and Bay-breasted warblers brings the largest numbers to that part of the coast lying between southern Texas and extreme western Florida (Figs. 43–46). The spring migration of the Black-poll (Figs. 47 and 48) and Prairie warblers is very similar to that described for the Cape May, except that many more precipitate on the southern Atlantic coast. Trans-Gulf migration for the rare Kirtland's Warbler is geographically most unlikely. With the probable exception of a small per cent of its total population, the Palm Warbler appears not to cross the Gulf in spring. The Oven-bird migrates on a broad front, but perhaps the most important flight crosses the Gulf (some northwestward?) to the stretch of coast from Galveston Bay to Pensacola, Florida. Essentially the same statement applies to the Northern Water-thrush, but the Louisiana Water-thrush converges (appropriately enough) mainly on the Louisiana coast. The northern and western Gulf receives the greatest numbers of Kentucky Warblers in spring, eastern Mexico and the Florida Peninsula apparently having but few (Figs. 49 and 50). The Connecticut Warbler is so rare that a dogmatic statement of its main migration route would be foolhardy, but there is no evidence that it concentrates on any major part of the southeastern United States. Mourning Warblers pass northward mainly along the Mexico-Texas coast and the record of "many" 30 miles off the Louisiana coast on the early date of April 2 (Frazar, 1881) is very surprising, to say the least. The Yellow-throat is a permanent resident along the Gulf coast, and the only definite clue to its migration route is the fact that numbers have been seen on the open Gulf on four occasions. It is possible that its migration on the sides of the Gulf is equal in volume. Most Yellow-breasted Chats move into the eastern United States through Mexico and Texas, but the likelihood that a few make the Gulf transit in spring should not be overlooked. The Hooded Warbler is a striking example of a trans-Gulf migrant, despite the fact that only two offshore records are known (Figs. 51 and 52). Many Wilson's and Canada warblers travel up the Mexico-Texas coast in spring, but there is evidence that some fly directly from Central America to Louisiana. The heaviest movements of American Redstarts are up the Florida Peninsula and across the central and western Gulf, with eight records on the Gulf.

ICTERIDAE. Although the Bobolink has frequently been mentioned as an example of a Florida Peninsula migrant, it was found in this study to occur most frequently on the Dry Tortugas and to be fairly common as far west as the Alabama coast. Taken in conjunction with three records on the Gulf, this leaves little doubt of Gulf-crossing by some individuals (Figs. 53 and 54). Both eastern species of orioles unquestionably follow trans-Gulf routes to a large extent, their center of abundance comprising the coasts of Texas and Louisiana (Figs. 55 and 56).

THRAUPIDAE. Tanagers are classic examples of trans-Gulf migrants. Most of the Scarlet Tanagers cross the coast line of Louisiana, Mississippi, and Alabama (Figs. 57 and 58), but the wider-ranging Summer Tanager is about equally common from northern Florida to Galveston Bay.

FRINGILLIDAE. Rose-breasted Grosbeaks are most numerous on the same parts of the Gulf Coast as Scarlet Tanagers, and the two species usually occur in the same waves (Figs. 59 and 60). Apparently the Blue Grosbeak is chiefly a trans-Gulf migrant, but there is great variation in abundance from one region to the next, and the values in eastern Mexico are not so low as for many other migrants. Available evidence points to a route across the western Gulf for the Indigo and Painted buntings, but in each case their status in eastern Mexico is somewhat uncertain. Dickcissels have not been recorded in eastern Mexico in numbers comparable to those on the Texas coast, and many are believed to take a shorter route from the Yucatan Peninsula to Texas (Figs. 61 and 62). There is little or no evidence for a trans-Gulf migration of the five species of sparrows included in this study (Savannah, Grasshopper, Lark, White-crowned, and Lincoln's), except for one record of the Grasshopper Sparrow on the open Gulf (Brooks, 1922).

Comparisons with Fall Migration

Although the subject of the coastal hiatus of spring transients has been adequately characterized and analyzed (Lowery, 1945; Williams, 1950), I know of no quantitative data which have been cited in support of this phenomenon. Numerical records of birds seen on field trips in the Tallahassee, Florida, region from September, 1946, through May, 1955, reveal some significant differences between the spring and fall migrations. Data in the fall of 1954 were omitted from the Leon County totals in order to equalize the amounts of time afield in spring (March through May) and fall (July through November), justifying numerical comparisons of the species considered. These figures, presented in Table 4, characteristically show greater contrast inland than on the coast for most species.

General Conclusions

Evidence bearing on the migration routes of spring migrants was adduced from direct observation, comparative abundance around the Gulf of Mexico, and the sequence of migration dates. Each line of evidence indicated that both the circum-Gulf and trans-Gulf routes are commonly utilized in spring. Approximately 40 species of summer residents, winter residents, and transients were found more frequently along the northern Gulf coast (exclusive of Texas) than on its eastern and western sides. Many species, however, were much less frequent there in spring than in fall, validating the theory of the coastal hiatus (Lowery, 1945). The larger numbers of species and individuals on the Texas coast are due to the fact that it makes up a part of both the trans-Gulf and circum-Gulf migration routes. It is thought prob-

TABLE 4

COMPARISONS OF NUMBERS OF BIRDS SEEN IN THE TALLAHASSEE, FLORIDA, REGION IN SPRING AND FALL, 1946-55

	Leon County (Inland)		Coastal Counties	
	Spring	Fall	Spring	Fall
Number of parties	5	5	12	10
Total hours in field	388	388	470	481.5
Species:				
Bank Swallow	3	116	7	46
Barn Swallow	56	536	305	1488
Cliff Swallow	—	2	—	5
Catbird[1]	6	67	90	267
Olive-backed Thrush	1	4	15	4
Gray-cheeked Thrush	—	2	7	4
Veery	—	19	1	12
Golden-winged Warbler	—	11	—	5
Blue-winged Warbler	1	4	2	4
Tennessee Warbler	1	73	2	16
Yellow Warbler	1	33	13	88
Magnolia Warbler	—	29	4	48
Black-throated Green Warbler	1	35	4	10
Cerulean Warbler	—	23	—	4
Blackburnian Warbler	—	47	3	21
Chestnut-sided Warbler	—	44	—	27
Bay-breasted Warbler	—	9	6	15
Northern Water-thrush	7	30	6	24
Hooded Warbler[2]	61	268	59	251
American Redstart	6	73	7	142
Scarlet Tanager	4	6	13	4
Rose-breasted Grosbeak	—	8	10	5

[1]A few are present in winter, especially near the coast.
[2]A few are present in summer.

able that most individual land birds tend to follow a direct route from their wintering grounds to their breeding grounds, but may be carried off course by strong winds. Therefore a part of the supposed coastwise migration in Texas and Florida may have begun as a trans-Gulf migration.

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